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A STANDARDIZATION OF METHODS FOR DETERMINATION OF THE ALCOHOL CONTENT OF BEVERAGES AND DISTILLED POTABLE SPIRITS

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BUTTERWORTHS

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I. INTRODUCTION

In laboratories engaged in official control of alcoholic products, the alcohol content is usually determined by the pycnometric method, which is based on measurement of the density of the alcohol–water solution. Strictly speaking, however, it is not the density itself that is measured in most methods, but a comparable quantity, the ratio of the density of an alcohol–water mixture to the density of water at the same temperature, called the specific gravity. Instead of that it may be the ratio between the weights of the liquid and the same volume of water in air at the temperature in question, the so-called "apparent specific gravity". Each quantity should be convertible by calculation to other units of measurement and give the equal alcohol content for the same alcohol–water mixture.

Practical experience has shown, however, that the value obtained for the alcohol content does, in fact, depend on the method used, and the explanation for this is to be found by studying the alcohol tables. These are based on experimentally measured densities of alcohol–water solutions and the alcohol content depends on the measurements on which the table is based. The discrepancies in the values of these densities which originally arose, still exist. Thus, the tables do not all give equal contents of alcohol for a known density or specific gravity. This is shown also in *Figure 1*, which presents the relationship of values from 0–100 per cent given in other tables to those of Osborne's alcohol table[1] or to the suggested table by the Fermentation Industries Section of the International Union of Pure and Applied Chemistry (IUPAC) (Section III, pp. 307–308). The percentage of alcohol according to Gay-Lussac is lower and the largest difference, 0·18 per cent, is found at an alcohol concentration of 18 per cent. The alcohol tables of Windisch and Tralles give higher values, with the largest difference of 0·14 per cent at a concentration of 12 per cent. This raises the argument that the measured densities include a systematic error derived either from impurities or from the minor water content of the alcohol used. But it is obvious from Osborne's report[1] that for the demands on distillation at that time one was capable of purifying alcohol well enough and hence the traces of impurities did not affect the results of measurements. The

† H. Suomalainen, Chairman (Finland), A. F. Langlykke, Vice Chairman (U.S.A.), F. Parisi, Secretary (Italy), K. Arima (Japan), P. Birolaud (France), H. J. Bunker (England), W. F. J. Cuthbertson (England), B. Drews (Germany), L. Genevois (France), J. Guymon (U.S.A.), R. F. Light (U.S.A.), H. Lundin (Sweden), I. Malék (Czechoslovakia), H. J. Peppler (U.S.A.).

remaining error may be due to the minor amount of water present in the alcohol. Kawasaki and co-workers of the National Research Laboratory of Metrology (Japan)[2] have determined the water content by Karl Fischer titration and, by means of an extrapolation, obtained for the density of alcohol of 100 per cent a value of 0·78927 at 20°C. The value given by

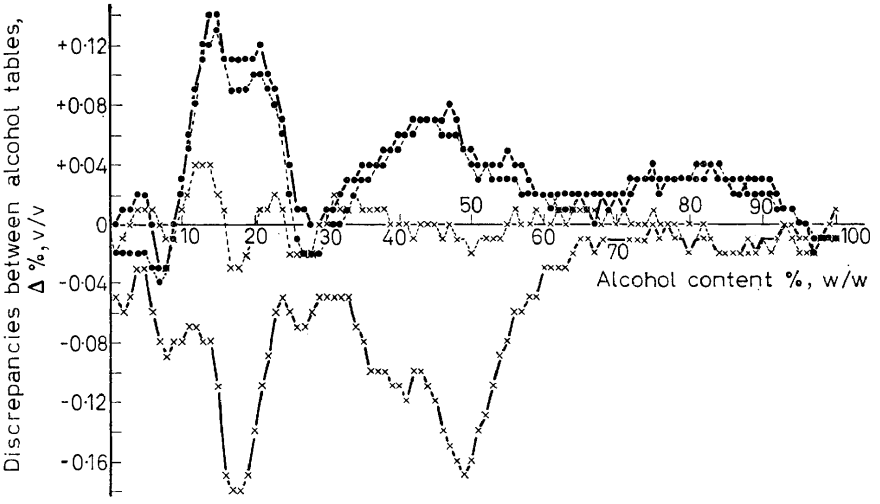

Figure 1. Deviations of the percentage by volume between Osborne's alcohol table and the alcohol table of Windisch (○—○), of Tralles ○— —○, of Kawasaki (X— —X) and of Gay-Lussac (X—X), calculated from the specific gravities.

Osborne, 0·78934, corresponds to an alcohol content of 99·98 per cent in Kawasaki's table. This difference has, however, no practical significance. The largest difference between the table of Kawasaki and that of Osborne is 0·04 per cent, but it should be noted that the differences appear in both negative and positive direction. On an average, these two tables give similar results. Under these circumstances it appears that the decision of IUPAC to adopt Osborne's work as a basis of reference is well founded.

The alcohol content, when expressed in percentages by volume, is influenced by temperature. Thus, in order that the alcohol contents determined in different countries may be comparable with each other, the method should be based on the same alcohol table and the same temperature. In several European countries the alcohol content is determined at 15°C and also according to the table of Tralles, at 15·56°C or 60°F. In the United Kingdom and in those countries outside Europe which have accepted the British units of measurement, the temperature used in determinations is almost without exception 60°F. To determine the alcohol content at 20°C has hitherto been more the exception than the rule, even though tables depending on this temperature have been available. However, suggestions

have been made in several different quarters[3–5] that this temperature should be chosen as the standard, particularly because of its nearness to normal room temperature. In spite of this, no uniform determination method or alcohol table has as yet been internationally accepted. Measurements are still performed at different temperatures and the alcohol contents are read from different tables.

While drawing up a survey of the fermentation industries of the world, the Fermentation Industries Section of IUPAC found that the divergent ways of expressing alcohol content, and particularly the use of mutually uncomparable units, have led to a great deal of confusion and misinterpretation. For this reason, the Section in July 1965 decided to include in its working programme the standardization of the methods for determination of the alcohol content as well as the drawing up of alcohol tables. At the meeting of the Section in Paris, on September 12–14, 1966, it was decided that a standardized method should be presented for the determination of the alcohol content at 20°C, and that an alcohol table for use with this method should be prepared on the basis of the densities of alcohol–water solutions determined by Osborne *et al.*[1] in 1913.†

By determining the coefficients for the equation of thermal expansion of alcohol–water mixtures Osborne has corrected the measured densities to the temperature of 25°C; the relative density of water at this temperature is reported by Chappuis[6] to be 0·997077. By means of the same equation the densities of alcohol solutions from 0 to 100 per cent are calculated to the temperatures between 10° and 40°C. At the same time when IUPAC worked on the draft of alcohol tables, the Office International de la Vigne et du Vin (OIV) proposed their own suggestion for alcohol tables which also is based on the densities determined by Osborne. In these tables, Jaulmes and Brun[7] have evaluated the thermal expansion coefficients of alcohol–water mixtures and further calculated the densities corresponding to the percentage by volume in the temperature range of 10°–30°C. The values obtained by calculation have been checked by experimental measurements. The results, thus obtained, agree well and hence confirm the correctness of the original table of Osborne.

For the alcohol table which is now to be outlined, the densities at 20°C were checked by transforming the values at 25°C to 20°C with the aid of the equation and the coefficients proposed by Osborne and thereafter calculating, by polynomial fitting in a computer the criterion for densities corresponding to alcohol contents between 0 and 100 per cent at intervals of one per cent. It was found that the density as a function of the alcohol content is satisfactorily defined by a polynomial of the 11th degree and the standard deviation is about one unit in the 5th decimal. Kawasaki and co-workers[2] arrived at the same conclusion when evaluating the density values of alcohol solutions measured by them from 55 basic values. Hence, it was considered justified to base the alcohol content on the specific gravity, D 20°/20°C, derived from the density values of Osborne at 20°C. Equal-

†This work has been carried out at the Research Laboratories of the Finnish State Alchohol Monopoly (Alko) under the supervision of Lalli Nykänen, M.Sc.

interval differences of one unit in the 4th decimal were calculated by non-linear inverse interpolation.

During the course of the work, the alcohol tables of Osborne were compared with some other alcohol tables currently in use. As reference values we have taken the densities reported by Osborne at the temperature in question, except at the temperature of 15·56°C, in which case the reference values have been obtained from the tables of specific gravity published by the National Bureau of Standards[8].

II. METHODS

1. General considerations

The determination of the alcohol content of beverages and distilled potable spirits forms the basis of the method. For alcoholic beverages which contain extracts, the alcohol content can only be measured after distillation (see p. 280). While the quantity to be determined is the ratio of masses or the specific gravity at 20°/20°C, the effect of buoyancy in air of the weights and other objects on the balance must be taken into account. The equations for calculating the reduction are derived and described in Section IV, p. 309

If the work involves large series and many measurements per day, the determinations can be performed rapidly and most accurately if the following constants are previously determined: the mass of the pycnometer m_0, the mass of the water content of the pycnometer m_w, and, further, the empty weights of the volumetric flasks weighed in air p_m, when distillates of beverages must be made (p. 280).

2. Determination of the mass of an empty pycnometer, m_0

A 50 ml pycnometer of Reischauer type (*Figure 2*), carefully cleaned and rinsed with distilled water, is dried at 105°C. The pycnometer is left to

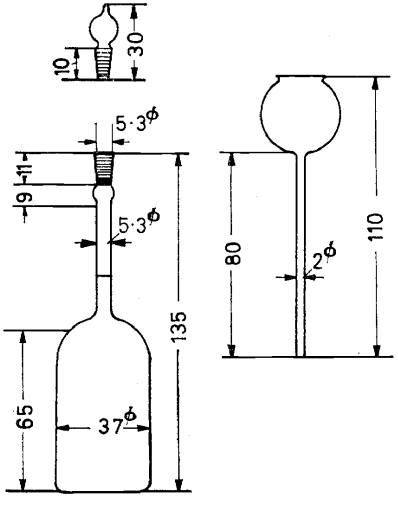

Figure 2. Pycnometer and funnel

cool in the balance room, after which the pycnometer, closed with a stopper, is weighed to an accuracy of 0·1 mg. The mass m_0 of the pycnometer is calculated from the equation

$$m_0 = p_0 \, (1 + \Delta_g)$$

where p_0 is the weight of the pycnometer in air and Δ_g the correction factor obtained from *Table 2.*

3. Determination of the mass m_w of the water content of the pycnometer

When the mass of the empty pycnometer has been determined, the pycnometer is immediately filled with recently distilled water so that the meniscus reaches to a little above the filling mark of the pycnometer. It is then closed with a stopper and placed in an electrically controlled water bath, the temperature of which is regulated to 20°C with a precision of 0·05°C. After 50 min, it is removed from the water bath and water is sucked away until the meniscus of the liquid remains about 3 mm above the filling mark, and the pycnometer is again placed in the water bath. This procedure has to be performed with care to ensure that no air bubbles appear in the pycnometer. After 10 min, the pycnometer is taken from the water bath and, without placing it on a table, the neck is dried rapidly and the stopper removed. The liquid is brought to the mark by careful sucking with a capillary tube along the neck of the pycnometer. The inside of the neck above the filling mark is dried with a piece of filter paper wound on a metal rod and the stopper is replaced. The pycnometer is now dried, first with a towel and then carefully with chamois leather, and transported on a wooden tray to the balance room, where it is left to stand for 30 minutes. The pycnometer filled with water is then weighed to an accuracy of at least 0·1 mg. The mass of the water content is calculated from the equation

$$m_w = (p_w - p_0) \, (1 + \Delta_w)$$

where p_w is the weight of the pycnometer filled with water, p_0 the weight of the empty pycnometer and Δ_w the correction factor of the weights obtained from *Table 3.*

4. Determination of the specific gravity 20°/20°C and the alcohol content of an alcoholic solution

When the mass of the empty pycnometer m_0 and the mass of the water m_w have been calculated, the pycnometer is filled with an alcoholic solution. The same procedure is followed as when the water mass was previously determined, and the pycnometer is finally weighed to an accuracy of 0·1 mg. Considering the variations of the air pressure and the temperature of the balance room, the specific gravity should, in accurate determinations, be calculated from the equation

$$D\ 20°/20°C = \frac{1}{m_w} \left[p_a - m_0 - d'_1 \left(\frac{p_a}{d_b} - \frac{m_0}{d_g} \right) \right] + \frac{d'_1}{d_w}$$

where m_w is the mass of the water content of the pycnometer at the measuring temperature, p_a the weight of the pycnometer filled with alcohol solution,

m_0 the mass of the empty pycnometer, d_b the density of the weights (= 8·4 g/cm³)†, d_g the density of glass (for Pyrex No. 7740 and Kimax KG–33 glasses, $d_g = 2{\cdot}23$ g/cm³)†, d'_i the density of air under the weighing conditions when the pycnometer is filled with the alcoholic solution, and d_w the relative density of water measured as g/ml at 20°C (= 0·99823). The density of air is obtained from *Table 4.*

The above equation for the specific gravity contains, in addition to m_0 and m_w, a constant term m_0/d_g, equal to the glass volume V_g of the pycnometer. At a fixed determination temperature the liquid content of the pycnometer remains invariable $V_l = m_w/d_w = m_a/d_a$. By adding the volume of the glass to that of the liquid content, a new constant term is obtained which expresses the total volume of the pycnometer $V_p = V_g + V_l = m_0/d_g + m_w/d_w$. When this is inserted in the expression for specific gravity, the following equation is obtained

$$D\ 20°/20°\text{C} = \frac{1}{m_w}\left[p_a - m_0 + d'_i\left(V_p - \frac{p_a}{d_b}\right)\right]$$

In most cases a sufficiently accurate approximation of specific gravity is obtained, when vacuum correction is performed with the mean value of air densities ($\bar{d}'_i$) observed while weighing the empty pycnometer, the pycnometer filled with water and with alcoholic solution. The specific gravity is thus calculated from the equation (see p. 311)

$$\bar{D}\ 20°/20°\text{C} = \frac{1}{d_w}\left[\frac{p_a - p_0}{p_w - p_0}(d_w - \bar{d}_i) + \bar{d}_i\right]$$

When the specific gravity of the alcohol solution D 20°/20°C or its approximate value $\bar{D}$ 20°/20°C is known, the corresponding alcohol content is obtained from the *Table 1.* While the specific gravity is normally determined with 5th decimal accuracy, the alcohol content can only be obtained accurately by interpolation.

5. Determination of the alcohol content of beverages

Approximately 50 ml of wine, or a correspondingly smaller amount of a stronger alcoholic beverage, is poured into a previously weighed 50-ml volumetric flask, and the flask is again weighed to an accuracy of 1 mg. The contents are emptied into a 250-ml boiling flask and rinsed three times with 10 ml of distilled water. The flask is connected to a distillation apparatus (*Figure 3*) and the volumetric flask used in the weighing procedure is placed as a collecting vessel without previous washing or drying. The speed of distillation is regulated in such a way that it can be performed in 15–20 minutes. The distillate, which must be clear or only slightly turbid, is collected in the volumetric flask until the meniscus of the liquid reaches to 1 cm above the filling mark. Thereafter the volumetric flask is dried and weighed to an accuracy of 1 mg. The flask is closed with a stopper and thoroughly shaken. The pycnometer is filled with the distillate and the specific gravity and the alcohol content of the distillate are determined

† For consistency of units, the densities of the weights and of glass properly should be also in g/ml; however, the numerical results for specific gravity calculated by the expression would be unaffected.

as stated above. Simultaneously, the specific gravity of the original beverage is determined pycnometrically. The alcohol content of the beverage is obtained from the following equations

$$\% \text{ (w/w)} = \frac{w \cdot p_t}{p_j}$$

where w is the alcohol content of the distillate in percentage by weight, p_t the weight of the distillate and p_j the weight of the beverage in air, and

$$\% \text{ (v/v)} = \frac{d_j \cdot w \cdot p_t}{0{\cdot}79074 \cdot p_j}$$

when, in addition to the above quantities, we have d_j, the specific gravity of the beverage, and 0·79074, the specific gravity of absolute alcohol at 20°C.

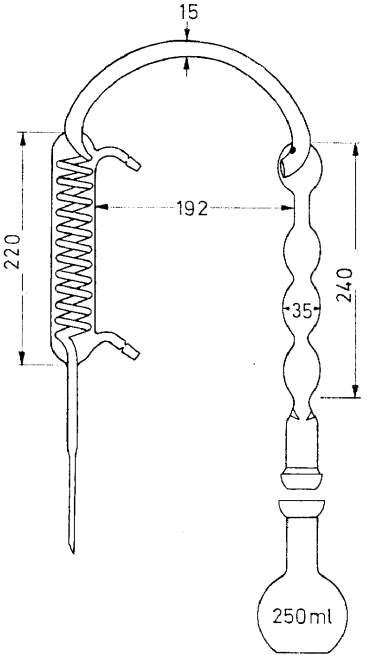

Figure 3. Distillation equipment for beverages

6. Examples of calculation

a. The mass of the empty pycnometer

The empty pycnometer closed with the stopper is weighed at the temperature of 23°C and under the air pressure of 780 mmHg. The uncorrected weight of the object is found to be $p_0 = 22{\cdot}6238$ g. The correction is obtained from the *Table 2*; $\Delta_g = 0{\cdot}000401$. The mass of the empty pycnometer is thus (p. 279)

$$m_0 = 22{\cdot}6238\ (1 + 0{\cdot}000401) = 22{\cdot}6329 \text{ g}.$$

b. The mass of the water content of the pycnometer

The pycnometer filled with water at 20°C is weighed under the same conditions as before and the uncorrected weight is now $p_w = 68{\cdot}0605$ g. When the correction, $\Delta_w = 0{\cdot}001076$, is taken from the *Table 3*, the mass of water, m_w, can be calculated (p. 279)

$$m_w = (68{\cdot}0605 - 22{\cdot}6238)\ (1 + 0{\cdot}001076) = 45{\cdot}4856 \text{ g.}$$

It is now convenient to evaluate the total volume of the pycnometer, V_p, which is obtained when the masses are divided with the densities.

$$V_p = \frac{22{\cdot}6329}{2{\cdot}23} + \frac{45{\cdot}4856}{0{\cdot}99823} = 55{\cdot}716 \text{ ml.}$$

c. Determination of the specific gravity 20°/20°C of the alcoholic solution and the alcohol content

The pycnometer filled with alcoholic solution at 20°C is weighed at the balance room temperature of 21°C and under the air pressure of 690 mmHg. The uncorrected weight of the pycnometer and the solution is $p_a = 62{\cdot}4568$ g. The air density, 0·001084, during the weighing is obtained from *Table 4*. When this and the density of brass, 8·4 g/cm³, and previously calculated values, m_0 and V_p, are taken into account, the specific gravity 20°/20°C is calculated by application of the appropriate equation (p. 280).

$$D\ 20°/20°\text{C} = \frac{1}{45{\cdot}4856}\left[62{\cdot}4568 - 22{\cdot}6329 + 0{\cdot}001084\left(55{\cdot}716 - \frac{62{\cdot}4568}{8{\cdot}4}\right)\right]$$

$$= \frac{1}{45{\cdot}4856}\left[62{\cdot}4568 - 22{\cdot}6329 + 0{\cdot}0523\right]$$

$$= \frac{39{\cdot}8762}{45{\cdot}4856} = 0{\cdot}87668$$

The corresponding alcohol content is obtained from the *Table 1*. It is found to be 66·85 per cent by weight or 74·12 per cent by volume.

d. Determination of the alcohol content of a beverage

Without the tare a lot of the beverage weighs 33·310 g and the collected distillate 54·531 g. By means of the pycnometric method the specific gravity 20°/20°C is found to be 0·99865 for the beverage and 0·96820 for the distillate corresponding to an alcohol content of 21·59 per cent by weight or 26·43 per cent by volume. The alcohol content of the beverage is thus d). 281)

$$\text{per cent by weight} = \frac{21{\cdot}59 \times 54{\cdot}531}{33{\cdot}310} = 35{\cdot}34\%\ (\text{w/w})$$

$$\text{and per cent by volume} = \frac{0{\cdot}99865 \times 21{\cdot}59 \times 54{\cdot}531}{0{\cdot}79074 \times 33{\cdot}310} = 44{\cdot}63\%\ (\text{v/v})$$

$$\text{or per cent by volume} = \frac{0{\cdot}99865 \times 26{\cdot}43 \times 54{\cdot}531}{0{\cdot}96820 \times 33{\cdot}310} = 44{\cdot}63\%\ (\text{v/v})$$

III. TABLES

Table 1. Specific gravities 20°/20°C of alcohol–water mixtures

Specific gravity (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml
1·0000	0·00	0·00	0·00	0·9950	2·72	3·43	2·70
0·9999	0·05	0·07	0·05	0·9949	2·78	3·50	2·76
0·9998	0·11	0·13	0·11	0·9948	2·84	3·57	2·82
0·9997	0·16	0·20	0·16	0·9947	2·89	3·64	2·87
0·9996	0·21	0·27	0·21	0·9946	2·95	3·71	2·93
0·9995	0·26	0·33	0·26	0·9945	3·01	3·78	2·98
0·9994	0·32	0·40	0·32	0·9944	3·06	3·85	3·04
0·9993	0·37	0·47	0·37	0·9943	3·12	3·92	3·10
0·9992	0·42	0·54	0·42	0·9942	3·18	3·99	3·15
0·9991	0·48	0·60	0·48	0·9941	3·23	4·07	3·21
0·9990	0·53	0·67	0·53	0·9940	3·29	4·14	3·27
0·9989	0·59	0·74	0·58	0·9939	3·35	4·21	3·32
0·9988	0·64	0·81	0·64	0·9938	3·41	4·28	3·38
0·9987	0·69	0·87	0·69	0·9937	3·47	4·36	3·44
0·9986	0·75	0·94	0·74	0·9936	3·52	4·43	3·49
0·9985	0·80	1·01	0·80	0·9935	3·58	4·50	3·55
0·9984	0·85	1·08	0·85	0·9934	3·64	4·57	3·61
0·9983	0·91	1·14	0·90	0·9933	3·70	4·65	3·67
0·9982	0·96	1·21	0·96	0·9932	3·76	4·72	3·72
0·9981	1·01	1·28	1·01	0·9931	3·82	4·79	3·78
0·9980	1·07	1·35	1·06	0·9930	3·87	4·87	3·84
0·9979	1·12	1·42	1·12	0·9929	3·93	4·94	3·90
0·9978	1·18	1·48	1·17	0·9928	3·99	5·01	3·96
0·9977	1·23	1·55	1·23	0·9927	4·05	5·09	4·02
0·9976	1·28	1·62	1·28	0·9926	4·11	5·16	4·07
0·9975	1·34	1·69	1·33	0·9925	4·17	5·23	4·13
0·9974	1·39	1·76	1·39	0·9924	4·23	5·31	4·19
0·9973	1·45	1·83	1·44	0·9923	4·29	5·38	4·25
0·9972	1·50	1·89	1·50	0·9922	4·35	5·46	4·31
0·9971	1·56	1·96	1·55	0·9921	4·41	5·53	4·37
0·9970	1·61	2·03	1·60	0·9920	4·47	5·61	4·43
0·9969	1·67	2·10	1·66	0·9919	4·53	5·68	4·49
0·9968	1·72	2·17	1·71	0·9918	4·59	5·76	4·55
0·9967	1·78	2·24	1·77	0·9917	4·65	5·83	4·61
0·9966	1·83	2·31	1·82	0·9916	4·71	5·91	4·67
0·9965	1·89	2·38	1·88	0·9915	4·77	5·99	4·73
0·9964	1·94	2·45	1·93	0·9914	4·84	6·06	4·79
0·9963	2·00	2·52	1·99	0·9913	4·90	6·14	4·85
0·9962	2·05	2·58	2·04	0·9912	4·96	6·22	4·91
0·9961	2·11	2·65	2·10	0·9911	5·02	6·29	4·97
0·9960	2·16	2·72	2·15	0·9910	5·08	6·37	5·03
0·9959	2·22	2·79	2·21	0·9909	5·15	6·45	5·09
0·9958	2·27	2·86	2·26	0·9908	5·21	6·53	5·15
0·9957	2·33	2·93	2·32	0·9907	5·27	6·60	5·21
0·9956	2·39	3·00	2·37	0·9906	5·33	6·68	5·27
0·9955	2·44	3·07	2·43	0·9905	5·40	6·76	5·34
0·9954	2·50	3·14	2·48	0·9904	5·46	6·84	5·40
0·9953	2·55	3·21	2·54	0·9903	5·52	6·92	5·46
0·9952	2·61	3·28	2·59	0·9902	5·59	7·00	5·52
0·9951	2·67	3·35	2·65	0·9901	5·65	7·07	5·58

Table 1 contd on p. 284

Table 1 (continued)

Specific gravity (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml
0·9900	5·71	7·15	5·65	0·9850	9·04	11·26	8·89
0·9899	5·78	7·23	5·71	0·9849	9·11	11·34	8·95
0·9898	5·84	7·31	5·77	0·9848	9·17	11·43	9·02
0·9897	5·90	7·39	5·83	0·9847	9·24	11·51	9·09
0·9896	5·97	7·47	5·90	0·9846	9·31	11·59	9·15
0·9895	6·03	7·55	5·96	0·9845	9·38	11·68	9·22
0·9894	6·10	7·63	6·02	0·9844	9·45	11·76	9·29
0·9893	6·16	7·71	6·09	0·9843	9·52	11·85	9·35
0·9892	6·23	7·79	6·15	0·9842	9·59	11·93	9·42
0·9891	6·29	7·87	6·21	0·9841	9·66	12·02	9·49
0·9890	6·36	7·95	6·28	0·9840	9·73	12·10	9·55
0·9889	6·42	8·03	6·34	0·9839	9·80	12·19	9·62
0·9888	6·49	8·11	6·40	0·9838	9·87	12·28	9·69
0·9887	6·55	8·19	6·47	0·9837	9·94	12·36	9·76
0·9886	6·62	8·27	6·53	0·9836	10·01	12·45	9·83
0·9885	6·68	8·35	6·59	0·9835	10·08	12·53	9·89
0·9884	6·75	8·44	6·66	0·9834	10·15	12·62	9·99
0·9883	6·81	8·52	6·72	0·9833	10·22	12·71	10·03
0·9882	6·88	8·60	6·79	0·9832	10·29	12·80	10·10
0·9881	6·95	8·68	6·85	0·9831	10·36	12·88	10·17
0·9880	7·01	8·76	6·92	0·9830	10·43	12·97	10·24
0·9879	7·08	8·84	6·98	0·9829	10·50	13·06	10·31
0·9878	7·15	8·93	7·05	0·9828	10·58	13·14	10·37
0·9877	7·21	9·01	7·11	0·9827	10·65	13·23	10·44
0·9876	7·28	9·09	7·18	0·9826	10·72	13·32	10·51
0·9875	7·35	9·17	7·24	0·9825	10·79	13·41	10·58
0·9874	7·41	9·26	7·31	0·9824	10·86	13·49	10·65
0·9873	7·48	9·34	7·37	0·9823	10·93	13·58	10·72
0·9872	7·55	9·42	7·44	0·9822	11·01	13·67	10·79
0·9871	7·61	9·51	7·50	0·9821	11·08	13·76	10·86
0·9870	7·68	9·59	7·57	0·9820	11·15	13·85	10·93
0·9869	7·75	9·67	7·63	0·9819	11·22	13·94	11·00
0·9868	7·82	9·75	7·70	0·9818	11·30	14·02	11·07
0·9867	7·88	9·84	7·76	0·9817	11·37	14·11	11·14
0·9866	7·95	9·92	7·83	0·9816	11·44	14·20	11·21
0·9865	8·02	10·00	7·90	0·9815	11·51	14·29	11·28
0·9864	8·09	10·09	7·96	0·9814	11·59	14·38	11·35
0·9863	8·15	10·17	8·03	0·9813	11·66	14·47	11·42
0·9862	8·22	10·25	8·09	0·9812	11·73	14·56	11·49
0·9861	8·29	10·34	8·16	0·9811	11·81	14·65	11·56
0·9860	8·36	10·42	8·22	0·9810	11·88	14·74	11·63
0·9859	8·42	10·50	8·29	0·9809	11·95	14·83	11·70
0·9858	8·49	10·59	8·36	0·9808	12·03	14·92	11·77
0·9857	8·56	10·67	8·42	0·9807	12·10	15·01	11·85
0·9856	8·63	10·75	8·49	0·9806	12·17	15·10	11·92
0·9855	8·69	10·84	8·55	0·9805	12·25	15·19	11·99
0·9854	8·76	10·92	8·62	0·9804	12·32	15·28	12·06
0·9853	8·83	11·00	8·69	0·9803	12·39	15·37	12·13
0·9852	8·90	11·09	8·75	0·9802	12·47	15·46	12·20
0·9851	8·97	11·17	8·82	0·9801	12·54	15·54	12·27

Table 1 contd on p. 285

Table 1 (continued)

Specific gravity (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml
0·9800	12·62	15·64	12·34	0·9750	16·47	20·30	16·03
0·9799	12·69	15·73	12·41	0·9749	16·55	20·40	16·10
0·9798	12·76	15·82	12·48	0·9748	16·62	20·49	16·18
0·9797	12·84	15·91	12·56	0·9747	16·70	20·59	16·25
0·9796	12·91	16·00	12·63	0·9746	16·78	20·68	16·32
0·9795	12·99	16·09	12·70	0·9745	16·86	20·77	16·40
0·9794	13·06	16·18	12·77	0·9744	16·93	20·87	16·47
0·9793	13·14	16·27	12·84	0·9743	17·01	20·96	16·54
0·9792	13·21	16·36	12·91	0·9742	17·09	21·05	16·62
0·9791	13·29	16·45	12·99	0·9741	17·17	21·15	16·69
0·9790	13·36	16·54	13·06	0·9740	17·24	21·24	16·76
0·9789	13·44	16·64	13·13	0·9739	17·32	21·33	16·84
0·9788	13·51	16·73	13·20	0·9738	17·40	21·42	16·91
0·9787	13·59	16·82	13·28	0·9737	17·47	21·52	16·98
0·9786	13·67	16·91	13·35	0·9736	17·55	21·61	17·06
0·9785	13·74	17·00	13·42	0·9735	17·63	21·70	17·13
0·9784	13·82	17·10	13·50	0·9734	17·70	21·79	17·20
0·9783	13·89	17·19	13·57	0·9733	17·78	21·89	17·28
0·9782	13·97	17·28	13·64	0·9732	17·86	21·98	17·35
0·9781	14·05	17·38	13·72	0·9731	17·93	22·07	17·42
0·9780	14·12	17·47	13·79	0·9730	18·01	22·16	17·49
0·9779	14·20	17·56	13·86	0·9729	18·09	22·25	17·56
0·9778	14·28	17·66	13·94	0·9728	18·16	22·34	17·64
0·9777	14·35	17·75	14·01	0·9727	18·24	22·43	17·71
0·9776	14·43	17·84	14·08	0·9726	18·31	22·52	17·78
0·9775	14·51	17·94	14·16	0·9725	18·39	22·62	17·85
0·9774	14·59	18·03	14·23	0·9724	18·46	22·71	17·92
0·9773	14·66	18·12	14·31	0·9723	18·54	22·80	17·99
0·9772	14·74	18·22	14·38	0·9722	18·61	22·89	18·07
0·9771	14·82	18·31	14·45	0·9721	18·69	22·98	18·14
0·9770	14·90	18·41	14·53	0·9720	18·77	23·07	18·21
0·9769	14·98	18·50	14·60	0·9719	18·84	23·16	18·28
0·9768	15·05	18·60	14·68	0·9718	18·92	23·25	18·35
0·9767	15·13	18·69	14·75	0·9717	18·99	23·34	18·42
0·9766	15·21	18·79	14·83	0·9716	19·07	23·43	18·49
0·9765	15·29	18·88	14·90	0·9715	19·14	23·52	18·56
0·9764	15·37	18·98	14·98	0·9714	19·22	23·61	18·64
0·9763	15·45	19·07	15·05	0·9713	19·29	23·70	18·71
0·9762	15·53	19·17	15·13	0·9712	19·37	23·79	18·78
0·9761	15·60	19·26	15·21	0·9711	19·44	23·88	18·85
0·9760	15·68	19·36	15·28	0·9710	19·52	23·97	18·92
0·9759	15·76	19·45	15·36	0·9709	19·59	24·06	18·99
0·9758	15·84	19·55	15·43	0·9708	19·67	24·15	19·06
0·9757	15·92	19·64	15·50	0·9707	19·74	24·24	19·13
0·9756	16·00	19·74	15·58	0·9706	19·82	24·33	19·20
0·9755	16·08	19·83	15·65	0·9705	19·89	24·42	19·27
0·9754	16·15	19·93	15·73	0·9704	19·97	24·51	19·34
0·9753	16·23	20·02	15·80	0·9703	20·04	24·59	19·41
0·9752	16·31	20·12	15·88	0·9702	20·12	24·68	19·48
0·9751	16·39	20·21	15·95	0·9701	20·19	24·77	19·55

Table 1 contd on p. 286

Table 1 (continued)

Specific gravity (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml
0·9700	20·27	24·86	19·62	0·9650	23·88	29·14	23·00
0·9699	20·34	24·95	19·69	0·9649	23·95	29·22	23·07
0·9698	20·41	25·04	19·76	0·9648	24·02	29·31	23·13
0·9697	20·49	25·12	19·83	0·9647	24·09	29·39	23·20
0·9696	20·56	25·21	19·90	0·9646	24·16	29·47	23·26
0·9695	20·64	25·30	19·97	0·9645	24·23	29·55	23·33
0·9694	20·71	25·39	20·04	0·9644	24·30	29·64	23·39
0·9693	20·78	25·48	20·11	0·9643	24·37	29·72	23·46
0·9692	20·86	25·56	20·18	0·9642	24·44	29·80	23·52
0·9691	20·93	25·65	20·25	0·9641	24·51	29·88	23·59
0·9690	21·00	25·74	20·32	0·9640	24·58	29·96	23·65
0·9689	21·08	25·83	20·39	0·9639	24·65	30·04	23·71
0·9688	21·15	25·91	20·45	0·9638	24·71	30·12	23·78
0·9687	21·22	26·00	20·52	0·9637	24·78	30·20	23·84
0·9686	21·30	26·09	20·59	0·9636	24·85	30·29	23·91
0·9685	21·37	26·17	20·66	0·9635	24·92	30·37	23·97
0·9684	21·44	26·26	20·73	0·9634	24·99	30·45	24·03
0·9683	21·52	26·35	20·80	0·9633	25·06	30·53	24·10
0·9682	21·59	26·43	20·86	0·9632	25·13	30·61	24·16
0·9681	21·66	26·52	20·93	0·9631	25·19	30·69	24·22
0·9680	21·73	26·61	21·00	0·9630	25·26	30·77	24·28
0·9679	21·81	26·69	21·07	0·9629	25·33	30·85	24·35
0·9678	21·88	26·78	21·14	0·9628	25·40	30·92	24·41
0·9677	21·95	26·86	21·20	0·9627	25·47	31·00	24·47
0·9676	22·02	26·95	21·27	0·9626	25·53	31·08	24·54
0·9675	22·10	27·04	21·34	0·9625	25·60	31·16	24·60
0·9674	22·17	27·12	21·41	0·9624	25·67	31·24	24·66
0·9673	22·24	27·21	21·47	0·9623	25·74	31·32	24·72
0·9672	22·31	27·29	21·54	0·9622	25·80	31·40	24·78
0·9671	22·38	27·38	21·61	0·9621	25·87	31·47	24·84
0·9670	22·46	27·46	21·68	0·9620	25·94	31·55	24·91
0·9669	22·53	27·55	21·74	0·9619	26·00	31·63	24·97
0·9668	22·60	27·63	21·81	0·9618	26·07	31·71	25·03
0·9667	22·67	27·72	21·88	0·9617	26·13	31·78	25·09
0·9666	22·74	27·80	21·94	0·9616	26·20	31·86	25·15
0·9665	22·81	27·89	22·01	0·9615	26·27	31·94	25·21
0·9664	22·89	27·97	22·08	0·9614	26·33	32·01	25·27
0·9663	22·96	28·05	22·14	0·9613	26·40	32·09	25·33
0·9662	23·03	28·14	22·21	0·9612	26·46	32·17	25·39
0·9661	23·10	28·22	22·28	0·9611	26·53	32·24	25·45
0·9660	23·17	28·31	22·34	0·9610	26·59	32·32	25·51
0·9659	23·24	28·39	22·41	0·9609	26·66	32·39	25·57
0·9658	23·31	28·47	22·48	0·9608	26·72	32·47	25·63
0·9657	23·38	28·56	22·54	0·9607	26·79	32·54	25·69
0·9656	23·46	28·64	22·61	0·9606	26·85	32·62	25·75
0·9655	23·53	28·73	22·67	0·9605	26·92	32·69	25·81
0·9654	23·60	28·81	22·74	0·9604	26·98	32·77	25·87
0·9653	23·67	28·89	22·81	0·9603	27·05	32·84	25·93
0·9652	23·74	28·98	22·87	0·9602	27·11	32·92	25·98
0·9651	23·81	29·06	22·94	0·9601	27·17	32·99	26·04

Table 1 contd on p. 287

Table 1 (continued)

Specific gravity (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml
0·9600	27·24	33·07	26·10	0·9550	30·30	36·60	28·89
0·9599	27·30	33·14	26·16	0·9549	30·36	36·66	28·94
0·9598	27·37	33·22	26·22	0·9548	30·42	36·73	28·99
0·9597	27·43	33·29	26·28	0·9547	30·48	36·80	29·05
0·9596	27·49	33·36	26·34	0·9546	30·54	36·87	29·10
0·9595	27·56	33·44	26·39	0·9545	30·60	36·93	29·15
0·9594	27·62	33·51	26·45	0·9544	30·66	37·00	29·21
0·9593	27·68	33·59	26·51	0·9543	30·71	37·07	29·26
0·9592	27·75	33·66	26·57	0·9542	30·77	37·13	29·31
0·9591	27·81	33·73	26·63	0·9541	30·83	37·20	29·36
0·9590	27·87	33·80	26·68	0·9540	30·89	37·27	29·42
0·9589	27·94	33·88	26·74	0·9539	30·95	37·33	29·47
0·9588	28·00	33·95	26·80	0·9538	31·00	37·40	29·52
0·9587	28·06	34·02	26·85	0·9537	31·06	37·46	29·57
0·9586	28·12	34·09	26·91	0·9536	31·12	37·53	29·62
0·9585	28·19	34·16	26·97	0·9535	31·18	37·60	29·68
0·9584	28·25	34·24	27·02	0·9534	31·24	37·66	29·73
0·9583	28·31	34·31	27·08	0·9533	31·29	37·73	29·78
0·9582	28·37	34·38	27·14	0·9532	31·35	37·79	29·83
0·9581	28·43	34·45	27·19	0·9531	31·41	37·86	29·88
0·9580	28·49	34·52	27·25	0·9530	31·47	37·92	29·93
0·9579	28·56	34·59	27·31	0·9529	31·52	37·99	29·99
0·9578	28·62	34·66	27·36	0·9528	31·58	38·05	30·04
0·9577	28·68	34·73	27·42	0·9527	31·64	38·12	30·09
0·9576	28·74	34·80	27·47	0·9526	31·70	38·18	30·14
0·9575	28·80	34·88	27·53	0·9525	31·75	38·25	30·19
0·9574	28·86	34·95	27·58	0·9524	31·81	38·31	30·24
0·9573	28·92	35·02	27·64	0·9523	31·87	38·38	30·29
0·9572	28·98	35·09	27·69	0·9522	31·92	38·44	30·34
0·9571	29·05	35·16	27·75	0·9521	31·98	38·51	30·39
0·9570	29·11	35·23	27·81	0·9520	32·04	38·57	30·45
0·9569	29·17	35·30	27·86	0·9519	32·09	38·63	30·50
0·9568	29·23	35·37	27·92	0·9518	32·15	38·70	30·55
0·9567	29·29	35·43	27·97	0·9517	32·21	38·76	30·60
0·9566	29·35	35·50	28·02	0·9516	32·26	38·83	30·65
0·9565	29·41	35·57	28·08	0·9515	32·32	38·89	30·70
0·9564	29·47	35·64	28·13	0·9514	32·38	38·95	30·75
0·9563	29·53	35·71	28·19	0·9513	32·43	39·02	30·80
0·9562	29·59	35·78	28·24	0·9512	32·49	39·08	30·85
0·9561	29·65	35·85	28·30	0·9511	32·54	39·14	30·90
0·9560	29·71	35·92	28·35	0·9510	32·60	39·21	30·95
0·9559	29·77	35·99	28·41	0·9509	32·66	39·27	31·00
0·9558	29·83	36·05	28·46	0·9508	32·71	39·33	31·05
0·9557	29·89	36·12	28·51	0·9507	32·77	39·40	31·10
0·9556	29·95	36·19	28·57	0·9506	32·82	39·46	31·15
0·9555	30·01	36·26	28·62	0·9505	32·88	39·52	31·20
0·9554	30·07	36·33	28·67	0·9504	32·93	39·58	31·25
0·9553	30·13	36·39	28·73	0·9503	32·99	39·65	31·29
0·9552	30·18	36·46	28·78	0·9502	33·05	39·71	31·34
0·9551	30·24	36·53	28·83	0·9501	33·10	39·77	31·39

Table 1 contd on p. 288

Table 1 (continued)

Specific gravity (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml
0·9500	33·16	39·83	31·44	0·9450	35·86	42·85	33·83
0·9499	33·21	39·90	31·49	0·9449	35·91	42·91	33·87
0·9498	33·27	39·96	31·54	0·9448	35·96	42·97	33·92
0·9497	33·32	40·02	31·59	0·9447	36·02	43·03	33·96
0·9496	33·38	40·08	31·64	0·9446	36·07	43·09	34·01
0·9495	33·43	40·15	31·69	0·9445	36·12	43·15	34·06
0·9494	33·49	40·21	31·74	0·9444	36·17	43·20	34·10
0·9493	33·54	40·27	31·79	0·9443	36·23	43·26	34·15
0·9492	33·60	40·33	31·84	0·9442	36·28	43·32	34·19
0·9491	33·65	40·39	31·89	0·9441	36·33	43·38	34·24
0·9490	33·71	40·46	31·93	0·9440	36·38	43·43	34·28
0·9489	33·76	40·52	31·98	0·9439	36·43	43·49	34·33
0·9488	33·82	40·58	32·03	0·9438	36·49	43·55	34·38
0·9487	33·87	40·64	32·08	0·9437	36·54	43·61	34·42
0·9486	33·93	40·70	32·13	0·9436	36·59	43·66	34·47
0·9485	33·98	40·76	32·18	0·9435	36·64	43·72	34·51
0·9484	34·04	40·82	32·22	0·9434	36·69	43·78	34·56
0·9483	34·09	40·88	32·27	0·9433	36·75	43·84	34·60
0·9482	34·15	40·95	32·32	0·9432	36·80	43·89	34·65
0·9481	34·20	41·01	32·37	0·9431	36·85	43·95	34·69
0·9480	34·25	41·07	32·42	0·9430	36·90	44·01	34·74
0·9479	34·31	41·13	32·46	0·9429	36·95	44·06	34·78
0·9478	34·36	41·19	32·51	0·9428	37·00	44·12	34·83
0·9477	34·42	41·25	32·56	0·9427	37·06	44·18	34·87
0·9476	34·47	41·31	32·61	0·9426	37·11	44·23	34·92
0·9475	34·52	41·37	32·65	0·9425	37·16	44·29	34·96
0·9474	34·58	41·43	32·70	0·9424	37·21	44·35	35·01
0·9473	34·63	41·49	32·75	0·9423	37·26	44·40	35·05
0·9472	34·69	41·55	32·80	0·9422	37·31	44·46	35·09
0·9471	34·74	41·61	32·84	0·9421	37·36	44·52	35·14
0·9470	34·79	41·67	32·89	0·9420	37·42	44·57	35·18
0·9469	34·85	41·73	32·94	0·9419	37·47	44·63	35·23
0·9468	34·90	41·79	32·99	0·9418	37·52	44·69	35·27
0·9467	34·95	41·85	33·03	0·9417	37·57	44·74	35·32
0·9466	35·01	41·91	33·08	0·9416	37·62	44·80	35·36
0·9465	35·06	41·97	33·13	0·9415	37·67	44·86	35·41
0·9464	35·12	42·03	33·17	0·9414	37·72	44·91	35·45
0·9463	35·17	42·09	33·22	0·9413	37·77	44·97	35·49
0·9462	35·22	42·15	33·27	0·9412	37·83	45·02	35·54
0·9461	35·28	42·21	33·32	0·9411	37·88	45·08	35·58
0·9460	35·33	42·27	33·36	0·9410	37·93	45·13	35·63
0·9459	35·38	42·32	33·41	0·9409	37·98	45·19	35·67
0·9458	35·44	42·38	33·46	0·9408	38·03	45·24	35·71
0·9457	35·49	42·44	33·50	0·9407	38·08	45·30	35·76
0·9456	35·54	42·50	33·55	0·9406	38·13	45·36	35·80
0·9455	35·60	42·56	33·60	0·9405	38·18	45·41	35·84
0·9454	35·65	42·62	33·64	0·9404	38·23	45·47	35·89
0·9453	35·70	42·68	33·69	0·9403	38·28	45·52	35·93
0·9452	35·75	42·74	33·73	0·9402	38·33	45·58	35·97
0·9451	35·81	42·80	33·78	0·9401	38·38	45·63	36·02

Table 1 contd on p. 289

Table 1 (continued)

Specific gravity (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml
0·9400	38·43	45·69	36·06	0·9350	40·90	48·36	38·17
0·9399	38·48	45·74	36·10	0·9349	40·95	48·41	38·22
0·9398	38·53	45·80	36·15	0·9348	41·00	48·47	38·26
0·9397	38·58	45·85	36·19	0·9347	41·05	48·52	38·30
0·9396	38·63	45·90	36·23	0·9346	41·09	48·57	38·34
0·9395	38·68	45·96	36·28	0·9345	41·14	48·62	38·38
0·9394	38·73	46·01	36·32	0·9344	41·19	48·67	38·42
0·9393	38·78	46·07	36·36	0·9343	41·24	48·73	38·46
0·9392	38·83	46·12	36·41	0·9342	41·29	48·78	38·50
0·9391	38·88	46·18	36·45	0·9341	41·34	48·83	38·54
0·9390	38·93	46·23	36·49	0·9340	41·38	48·88	38·59
0·9389	38·98	46·28	36·53	0·9339	41·43	48·93	38·63
0·9388	39·03	46·34	36·58	0·9338	41·48	48·99	38·67
0·9387	39·08	46·39	36·62	0·9337	41·53	49·04	38·71
0·9386	39·13	46·45	36·66	0·9336	41·58	49·09	38·75
0·9385	39·18	46·50	36·71	0·9335	41·63	49·14	38·79
0·9384	39·23	46·55	36·75	0·9334	41·67	49·19	38·83
0·9383	39·28	46·61	36·79	0·9333	41·72	49·24	38·87
0·9382	39·33	46·66	36·83	0·9332	41·77	49·30	38·91
0·9381	39·38	46·72	36·88	0·9331	41·82	49·35	38·95
0·9380	39·43	46·77	36·92	0·9330	41·87	49·40	38·99
0·9379	39·48	46·82	36·96	0·9329	41·91	49·45	39·03
0·9378	39·53	46·88	37·00	0·9328	41·96	49·50	39·07
0·9377	39·58	46·93	37·04	0·9327	42·01	49·55	39·11
0·9376	39·62	46·98	37·09	0·9326	42·06	49·60	39·15
0·9375	39·67	47·04	37·13	0·9325	42·11	49·65	39·19
0·9374	39·72	47·09	37·17	0·9324	42·15	49·71	39·23
0·9373	39·77	47·14	37·21	0·9323	42·20	49·76	39·27
0·9372	39·82	47·20	37·25	0·9322	42·25	49·81	39·31
0·9371	39·87	47·25	37·30	0·9321	42·30	49·86	39·35
0·9370	39·92	47·30	37·34	0·9320	42·34	49·91	39·39
0·9369	39·97	47·36	37·38	0·9319	42·39	49·96	39·43
0·9368	40·02	47·41	37·42	0·9318	42·44	50·01	39·47
0·9367	40·07	47·46	37·47	0·9317	42·49	50·06	39·51
0·9366	40·12	47·52	37·51	0·9316	42·53	50·11	39·55
0·9365	40·17	47·57	37·55	0·9315	42·58	50·16	39·59
0·9364	40·22	47·62	37·59	0·9314	42·63	50·21	39·63
0·9363	40·26	47·68	37·63	0·9313	42·68	50·26	39·67
0·9362	40·31	47·73	37·67	0·9312	42·72	50·31	39·71
0·9361	40·36	47·78	37·72	0·9311	42·77	50·36	39·75
0·9360	40·41	47·84	37·76	0·9310	42·82	50·41	39·79
0·9359	40·46	47·89	37·80	0·9309	42·87	50·46	39·83
0·9358	40·51	47·94	37·84	0·9308	42·91	50·51	39·87
0·9357	40·56	47·99	37·88	0·9307	42·96	50·56	39·91
0·9356	40·61	48·05	37·93	0·9306	43·01	50·62	39·95
0·9355	40·66	48·10	37·97	0·9305	43·06	50·67	39·99
0·9354	40·71	48·15	38·01	0·9304	43·10	50·72	40·03
0·9353	40·75	48·20	38·05	0·9303	43·15	50·77	40·07
0·9352	40·80	48·26	38·09	0·9302	43·20	50·82	40·11
0·9351	40·85	48·31	38·13	0·9301	43·24	50·87	40·15

Table 1 contd on p. 290

Table 1 (continued)

Specific gravity (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml
0·9300	43·29	50·92	40·19	0·9250	45·63	53·38	42·13
0·9299	43·34	50·97	40·23	0·9249	45·68	53·43	42·17
0·9298	43·39	51·02	40·27	0·9248	45·72	53·48	42·21
0·9297	43·43	51·07	40·31	0·9247	45·77	53·52	42·25
0·9296	43·48	51·12	40·35	0·9246	45·82	53·57	42·29
0·9295	43·53	51·16	40·39	0·9245	45·86	53·62	42·33
0·9294	43·57	51·21	40·43	0·9244	45·91	53·67	42·36
0·9293	43·62	51·26	40·46	0·9243	45·96	53·72	42·40
0·9292	43·67	51·31	40·50	0·9242	46·00	53·77	42·44
0·9291	43·71	51·36	40·54	0·9241	46·05	53·82	42·48
0·9290	43·76	51·41	40·58	0·9240	46·10	53·86	42·52
0·9289	43·81	51·46	40·62	0·9239	46·14	53·91	42·55
0·9288	43·86	51·51	40·66	0·9238	46·19	53·96	42·59
0·9287	43·90	51·56	40·70	0·9237	46·23	54·01	42·63
0·9286	43·95	51·61	40·74	0·9236	46·28	54·06	42·67
0·9285	44·00	51·66	40·78	0·9235	46·33	54·10	42·71
0·9284	44·04	51·71	40·82	0·9234	46·37	54·15	42·75
0·9283	44·09	51·76	40·86	0·9233	46·42	54·20	42·78
0·9282	44·14	51·81	40·90	0·9232	46·47	54·25	42·82
0·9281	44·18	51·86	40·94	0·9231	46·51	54·30	42·86
0·9280	44·23	51·91	40·97	0·9230	46·56	54·35	42·90
0·9279	44·28	51·96	41·01	0·9229	46·60	54·39	42·94
0·9278	44·33	52·01	41·05	0·9228	46·65	54·44	42·97
0·9277	44·37	52·06	41·09	0·9227	46·70	54·49	43·01
0·9276	44·42	52·11	41·13	0·9226	46·74	54·54	43·05
0·9275	44·47	52·16	41·17	0·9225	46·79	54·59	43·09
0·9274	44·51	52·21	41·21	0·9224	46·84	54·63	43·12
0·9273	44·56	52·26	41·25	0·9223	46·88	54·68	43·16
0·9272	44·61	52·31	41·29	0·9222	46·93	54·73	43·20
0·9271	44·65	52·35	41·33	0·9221	46·97	54·78	43·24
0·9270	44·70	52·40	41·36	0·9220	47·02	54·82	43·28
0·9269	44·75	52·45	41·40	0·9219	47·07	54·87	43·31
0·9268	44·79	52·50	41·44	0·9218	47·11	54·92	43·35
0·9267	44·84	52·55	41·48	0·9217	47·16	54·97	43·39
0·9266	44·89	52·60	41·52	0·9216	47·20	55·01	43·43
0·9265	44·93	52·65	41·56	0·9215	47·25	55·06	43·46
0·9264	44·98	52·70	41·60	0·9214	47·29	55·11	43·50
0·9263	45·03	52·75	41·64	0·9213	47·34	55·16	43·54
0·9262	45·07	52·80	41·67	0·9212	47·39	55·20	43·58
0·9261	45·12	52·84	41·71	0·9211	47·43	55·25	43·61
0·9260	45·17	52·89	41·75	0·9210	47·48	55·30	43·65
0·9259	45·21	52·94	41·79	0·9209	47·52	55·35	43·69
0·9258	45·26	52·99	41·83	0·9208	47·57	55·39	43·72
0·9257	45·31	53·04	41·87	0·9207	47·62	55·44	43·76
0·9256	45·35	53·09	41·90	0·9206	47·66	55·49	43·80
0·9255	45·40	53·14	41·94	0·9205	47·71	55·54	43·84
0·9254	45·45	53·19	41·98	0·9204	47·75	55·58	43·87
0·9253	45·49	53·23	42·02	0·9203	47·80	55·63	43·91
0·9252	45·54	53·28	42·06	0·9202	47·84	55·68	43·95
0·9251	45·59	53·33	42·10	0·9201	47·89	55·72	43·99

Table 1 contd on p. 291

Table 1 (continued)

Specific gravity (20/20)	*Per cent* by weight	by volume	*G in* 100ml	*Specific gravity* (20/20)	*Per cent* by weight	by volume	*G in* 100ml
0·9200	47·94	55·77	44·02	0·9150	50·21	58·10	45·86
0·9199	47·98	55·82	44·06	0·9149	50·25	58·14	45·89
0·9198	48·03	55·87	44·10	0·9148	50·30	58·19	45·93
0·9197	48·07	55·91	44·13	0·9147	50·34	58·23	45·96
0·9196	48·12	55·96	44·17	0·9146	50·38	58·28	46·00
0·9195	48·16	56·01	44·21	0·9145	50·43	58·32	46·04
0·9194	48·21	56·05	44·25	0·9144	50·47	58·37	46·07
0·9193	48·25	56·10	44·28	0·9143	50·52	58·41	46·11
0·9192	48·30	56·15	44·32	0·9142	50·56	58·46	46·14
0·9191	48·35	56·19	44·36	0·9141	50·61	58·50	46·18
0·9190	48·39	56·24	44·39	0·9140	50·65	58·55	46·21
0·9189	48·44	56·29	44·43	0·9139	50·70	58·59	46·25
0·9188	48·48	56·33	44·47	0·9138	50·74	58·64	46·28
0·9187	48·53	56·38	44·50	0·9137	50·78	58·68	46·32
0·9186	48·57	56·43	44·54	0·9136	50·83	58·73	46·36
0·9185	48·62	56·47	44·58	0·9135	50·87	58·77	46·39
0·9184	48·66	56·52	44·61	0·9134	50·92	58·82	46·43
0·9183	48·71	56·57	44·65	0·9133	50·96	58·86	46·46
0·9182	48·76	56·61	44·69	0·9132	51·01	58·91	46·50
0·9181	48·80	56·66	44·73	0·9131	51·05	58·95	46·53
0·9180	48·85	56·71	44·76	0·9130	51·10	59·00	46·57
0·9179	48·89	56·75	44·80	0·9129	51·14	59·04	46·60
0·9178	48·94	56·80	44·84	0·9128	51·19	59·09	46·64
0·9177	48·98	56·85	44·87	0·9127	51·23	59·13	46·68
0·9176	49·03	56·90	44·91	0·9126	51·27	59·18	46·71
0·9175	49·07	56·94	44·95	0·9125	51·32	59·22	46·75
0·9174	49·12	56·99	44·98	0·9124	51·36	59·27	46·78
0·9173	49·17	57·04	45·02	0·9123	51·41	59·31	46·82
0·9172	49·21	57·08	45·06	0·9122	51·45	59·36	46·85
0·9171	49·26	57·13	45·09	0·9121	51·50	59·40	46·89
0·9170	49·30	57·17	45·13	0·9120	51·54	59·45	46·92
0·9169	49·35	57·22	45·17	0·9119	51·59	59·49	46·96
0·9168	49·39	57·27	45·20	0·9118	51·63	59·54	46·99
0·9167	49·44	57·31	45·24	0·9117	51·68	59·58	47·03
0·9166	49·48	57·36	45·28	0·9116	51·72	59·63	47·07
0·9165	49·53	57·41	45·32	0·9115	51·77	59·67	47·10
0·9164	49·58	57·46	45·35	0·9114	51·81	59·72	47·14
0·9163	49·62	57·50	45·39	0·9113	51·85	59·76	47·17
0·9162	49·67	57·55	45·42	0·9112	51·90	59·80	47·21
0·9161	49·71	57·59	45·46	0·9111	51·94	59·85	47·24
0·9160	49·76	57·64	45·50	0·9110	51·99	59·89	47·28
0·9159	49·80	57·69	45·53	0·9109	52·03	59·94	47·31
0·9158	49·85	57·73	45·57	0·9108	52·08	59·98	47·35
0·9157	49·89	57·78	45·61	0·9107	52·12	60·03	47·38
0·9156	49·94	57·82	45·64	0·9106	52·17	60·07	47·42
0·9155	49·98	57·87	45·68	0·9105	52·21	60·12	47·45
0·9154	50·03	57·91	45·71	0·9104	52·25	60·16	47·49
0·9153	50·07	57·96	45·75	0·9103	52·30	60·21	47·52
0·9152	50·12	58·00	45·79	0·9102	52·34	60·25	47·56
0·9151	50·16	58·05	45·82	0·9101	52·39	60·30	47·59

Table 1 contd on p. 292

Table 1 (continued)

Specific gravity (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml
0·9100	52·43	60·34	47·63	0·9050	54·64	62·53	49·36
0·9099	52·48	60·38	47·66	0·9049	54·68	62·58	49·40
0·9098	52·52	60·43	47·70	0·9048	54·73	62·62	49·43
0·9097	52·57	60·47	47·73	0·9047	54·77	62·66	49·46
0·9096	52·61	60·52	47·77	0·9046	54·82	62·71	49·50
0·9095	52·65	60·56	47·80	0·9045	54·86	62·75	49·53
0·9094	52·70	60·61	47·84	0·9044	54·90	62·80	49·57
0·9093	52·74	60·65	47·87	0·9043	54·95	62·84	49·60
0·9092	52·79	60·69	47·91	0·9042	54·99	62·88	49·64
0·9091	52·83	60·74	47·94	0·9041	55·04	62·93	49·67
0·9090	52·88	60·78	47·98	0·9040	55·08	62·97	49·70
0·9089	52·92	60·83	48·01	0·9039	55·12	63·01	49·74
0·9088	52·96	60·87	48·05	0·9038	55·17	63·06	49·77
0·9087	53·01	60·92	48·08	0·9037	55·21	63·10	49·81
0·9086	53·05	60·96	48·12	0·9036	55·26	63·14	49·84
0·9085	53·10	61·00	48·15	0·9035	55·30	63·19	49·87
0·9084	53·14	61·05	48·19	0·9034	55·34	63·23	49·91
0·9083	53·19	61·09	48·22	0·9033	55·39	63·27	49·94
0·9082	53·23	61·14	48·26	0·9032	55·43	63·31	49·98
0·9081	53·27	61·18	48·29	0·9031	55·48	63·36	50·01
0·9080	53·32	61·22	48·33	0·9030	55·52	63·40	50·05
0·9079	53·36	61·27	48·36	0·9029	55·56	63·44	50·08
0·9078	53·41	61·31	48·40	0·9028	55·61	63·49	50·11
0·9077	53·45	61·36	48·43	0·9027	55·65	63·53	50·15
0·9076	53·49	61·40	48·47	0·9026	55·70	63·57	50·18
0·9075	53·54	61·44	48·50	0·9025	55·74	63·62	50·22
0·9074	53·58	61·49	48·54	0·9024	55·78	63·66	50·25
0·9073	53·63	61·53	48·57	0·9023	55·83	63·70	50·28
0·9072	53·67	61·58	48·60	0·9022	55·87	63·75	50·32
0·9071	53·72	61·62	48·64	0·9021	55·92	63·79	50·35
0·9070	53·76	61·66	48·67	0·9020	55·96	63·83	50·39
0·9069	53·80	61·71	48·71	0·9019	56·00	63·88	50·42
0·9068	53·85	61·75	48·74	0·9018	56·05	63·92	50·45
0·9067	53·89	61·79	48·78	0·9017	56·09	63·96	50·49
0·9066	53·94	61·84	48·81	0·9016	56·13	64·00	50·52
0·9065	53·98	61·88	48·85	0·9015	56·18	64·05	50·56
0·9064	54·02	61·93	48·88	0·9014	56·22	64·09	50·59
0·9063	54·07	61·97	48·92	0·9013	56·27	64·13	50·62
0·9062	54·11	62·01	48·95	0·9012	56·31	64·18	50·66
0·9061	54·16	62·06	48·98	0·9011	56·35	64·22	50·69
0·9060	54·20	62·10	49·02	0·9010	56·40	64·26	50·72
0·9059	54·24	62·14	49·05	0·9009	56·44	64·30	50·76
0·9058	54·29	62·19	49·09	0·9008	56·48	64·35	50·79
0·9057	54·33	62·23	49·12	0·9007	56·53	64·39	50·83
0·9056	54·38	62·27	49·16	0·9006	56·57	64·43	50·86
0·9055	54·42	62·32	49·19	0·9005	56·62	64·47	50·89
0·9054	54·46	62·36	49·22	0·9004	56·66	64·52	50·93
0·9053	54·51	62·40	49·26	0·9003	56·70	64·56	50·96
0·9052	54·55	62·45	49·29	0·9002	56·75	64·60	50·99
0·9051	54·60	62·49	49·33	0·9001	56·79	64·65	51·03

Table 1 contd on p. 293

Table 1 (continued)

Specific gravity (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml
0·9000	56·83	64·69	51·06	0·8950	59·01	66·79	52·72
0·8999	56·88	64·73	51·09	0·8949	59·05	66·83	52·75
0·8998	56·92	64·77	51·13	0·8948	59·10	66·87	52·79
0·8997	56·97	64·82	51·16	0·8947	59·14	66·92	52·82
0·8996	57·01	64·86	51·20	0·8946	59·18	66·96	52·85
0·8995	57·05	64·90	51·23	0·8945	59·23	67·00	52·88
0·8994	57·10	64·94	51·26	0·8944	59·27	67·04	52·92
0·8993	57·14	64·99	51·30	0·8943	59·31	67·08	52·95
0·8992	57·18	65·03	51·33	0·8942	59·36	67·12	52·98
0·8991	57·23	65·07	51·36	0·8941	59·40	67·16	53·02
0·8990	57·27	65·11	51·40	0·8940	59·44	67·21	53·05
0·8989	57·32	65·16	51·43	0·8939	59·49	67·25	53·08
0·8988	57·36	65·20	51·46	0·8938	59·53	67·29	53·11
0·8987	57·40	65·24	51·50	0·8937	59·57	67·33	53·15
0·8986	57·45	65·28	51·53	0·8936	59·62	67·37	53·18
0·8985	57·49	65·32	51·56	0·8935	59·66	67·41	53·21
0·8984	57·53	65·37	51·60	0·8934	59·70	67·45	53·24
0·8983	57·58	65·41	51·63	0·8933	59·74	67·49	53·28
0·8982	57·62	65·45	51·66	0·8932	59·79	67·54	53·31
0·8981	57·66	65·49	51·70	0·8931	59·83	67·58	53·34
0·8980	57·71	65·54	51·73	0·8930	59·87	67·62	53·37
0·8979	57·75	65·58	51·76	0·8929	59·92	67·66	53·41
0·8978	57·79	65·62	51·80	0·8928	59·96	67·70	53·44
0·8977	57·84	65·66	51·83	0·8927	60·00	67·74	53·47
0·8976	57·88	65·70	51·86	0·8926	60·05	67·78	53·50
0·8975	57·93	65·75	51·90	0·8925	60·09	67·82	53·54
0·8974	57·97	65·79	51·93	0·8924	60·13	67·87	53·57
0·8973	58·01	65·83	51·96	0·8923	60·18	67·91	53·60
0·8972	58·06	65·87	52·00	0·8922	60·22	67·95	53·63
0·8971	58·10	65·91	52·03	0·8921	60·26	67·99	53·67
0·8970	58·14	65·96	52·06	0·8920	60·31	68·03	53·70
0·8969	58·19	66·00	52·09	0·8919	60·35	68·07	53·73
0·8968	58·23	66·04	52·13	0·8918	60·39	68·11	53·76
0·8967	58·27	66·08	52·16	0·8917	60·44	68·15	53·80
0·8966	58·32	66·12	52·19	0·8916	60·48	68·19	53·83
0·8965	58·36	66·17	52·23	0·8915	60·52	68·24	53·86
0·8964	58·40	66·21	52·26	0·8914	60·57	68·28	53·89
0·8963	58·45	66·25	52·29	0·8913	60·61	68·32	53·93
0·8962	58·49	66·29	52·33	0·8912	60·65	68·36	53·96
0·8961	58·53	66·33	52·36	0·8911	60·70	68·40	53·99
0·8960	58·58	66·37	52·39	0·8910	60·74	68·44	54·02
0·8959	58·62	66·42	52·43	0·8909	60·78	68·48	54·06
0·8958	58·66	66·46	52·46	0·8908	60·83	68·52	54·09
0·8957	58·71	66·50	52·49	0·8907	60·87	68·56	54·12
0·8956	58·75	66·54	52·52	0·8906	60·91	68·60	54·15
0·8955	58·79	66·58	52·56	0·8905	60·96	68·65	54·18
0·8954	58·84	66·62	52·59	0·8904	61·00	68·69	54·22
0·8953	58·88	66·67	52·62	0·8903	61·04	68·73	54·25
0·8952	58·92	66·71	52·66	0·8902	61·08	68·77	54·28
0·8951	58·97	66·75	52·69	0·8901	61·13	68·81	54·31

Table 1 contd on p. 294

Table 1 (continued)

Specific gravity (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml
0·8900	61·17	68·85	54·35	0·8850	63·32	70·86	55·93
0·8899	61·21	68·89	54·38	0·8849	63·36	70·90	55·97
0·8898	61·26	68·93	54·41	0·8848	63·40	70·94	56·00
0·8897	61·30	68·97	54·44	0·8847	63·44	70·98	56·03
0·8896	61·34	69·01	54·47	0·8846	63·49	71·02	56·06
0·8895	61·39	69·05	54·51	0·8845	63·53	71·06	56·09
0·8894	61·43	69·09	54·54	0·8844	63·57	71·10	56·12
0·8893	61·47	69·13	54·57	0·8843	63·61	71·14	56·15
0·8892	61·52	69·17	54·60	0·8842	63·66	71·18	56·19
0·8891	61·56	69·22	54·63	0·8841	63·70	71·22	56·22
0·8890	61·60	69·26	54·67	0·8840	63·74	71·26	56·25
0·8889	61·64	69·30	54·70	0·8839	63·78	71·30	56·28
0·8888	61·69	69·34	54·73	0·8838	63·83	71·34	56·31
0·8887	61·73	69·38	54·76	0·8837	63·87	71·38	56·34
0·8886	61·77	69·42	54·79	0·8836	63·91	71·42	56·37
0·8885	61·82	69·46	54·83	0·8835	63·95	71·46	56·40
0·8884	61·86	69·50	54·86	0·8834	64·00	71·50	56·44
0·8883	61·90	69·54	54·89	0·8833	64·04	71·54	56·47
0·8882	61·94	69·58	54·92	0·8832	64·08	71·58	56·50
0·8881	61·99	69·62	54·95	0·8831	64·12	71·61	56·53
0·8880	62·03	69·66	54·99	0·8830	64·17	71·65	56·56
0·8879	62·07	69·70	55·02	0·8829	64·21	71·69	56·59
0·8878	62·12	69·74	55·05	0·8828	64·25	71·73	56·62
0·8877	62·16	69·78	55·08	0·8827	64·29	71·77	56·65
0·8876	62·20	69·82	55·11	0·8826	64·34	71·81	56·68
0·8875	62·25	69·86	55·15	0·8825	64·38	71·85	56·71
0·8874	62·29	69·90	55·18	0·8824	64·42	71·89	56·75
0·8873	62·33	69·94	55·21	0·8823	64·46	71·93	56·78
0·8872	62·37	69·98	55·24	0·8822	64·51	71·97	56·81
0·8871	62·42	70·02	55·27	0·8821	64·55	72·01	56·84
0·8870	62·46	70·06	55·30	0·8820	64·59	72·05	56·87
0·8869	62·50	70·10	55·34	0·8819	64·63	72·09	56·90
0·8868	62·55	70·14	55·37	0·8818	64·68	72·12	56·93
0·8867	62·59	70·18	55·40	0·8817	64·72	72·16	56·96
0·8866	62·63	70·22	55·43	0·8816	64·76	72·20	56·99
0·8865	62·67	70·26	55·46	0·8815	64·80	72·24	57·02
0·8864	62·72	70·30	55·49	0·8814	64·85	72·28	57·05
0·8863	62·76	70·34	55·53	0·8813	64·89	72·32	57·09
0·8862	62·80	70·38	55·56	0·8812	64·93	72·36	57·12
0·8861	62·85	70·42	55·59	0·8811	64·97	72·40	57·15
0·8860	62·89	70·46	55·62	0·8810	65·02	72·44	57·18
0·8859	62·93	70·50	55·65	0·8809	65·06	72·48	57·21
0·8858	62·97	70·54	55·68	0·8808	65·10	72·52	57·24
0·8857	63·02	70·58	55·71	0·8807	65·14	72·56	57·27
0·8856	63·06	70·62	55·75	0·8806	65·19	72·59	57·30
0·8855	63·10	70·66	55·78	0·8805	65·23	72·63	57·33
0·8854	63·14	70·70	55·81	0·8804	65·27	72·67	57·36
0·8853	63·19	70·74	55·84	0·8803	65·31	72·71	57·39
0·8852	63·23	70·78	55·87	0·8802	65·36	72·75	57·43
0·8851	63·27	70·82	55·90	0·8801	65·40	72·79	57·46

Table 1 contd on p. 295

Table 1 (continued)

Specific gravity (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml
0·8800	65·44	72·83	57·49	0·8750	67·56	74·76	59·01
0·8799	65·48	72·87	57·52	0·8749	67·60	74·80	59·04
0·8798	65·53	72·91	57·55	0·8748	67·64	74·83	59·07
0·8797	65·57	72·95	57·58	0·8747	67·69	74·87	59·10
0·8796	65·61	72·99	57·61	0·8746	67·73	74·91	59·13
0·8795	65·65	73·02	57·64	0·8745	67·77	74·95	59·16
0·8794	65·70	73·06	57·67	0·8744	67·81	74·99	59·19
0·8793	65·74	73·10	57·70	0·8743	67·86	75·03	59·22
0·8792	65·78	73·14	57·73	0·8742	67·90	75·06	59·25
0·8791	65·82	73·18	57·76	0·8741	67·94	75·10	59·28
0·8790	65·87	73·22	57·79	0·8740	67·98	75·14	59·31
0·8789	65·91	73·26	57·82	0·8739	68·02	75·18	59·34
0·8788	65·95	73·30	57·86	0·8738	68·07	75·22	59·37
0·8787	65·99	73·33	57·89	0·8737	68·11	75·25	59·40
0·8786	66·04	73·37	57·92	0·8736	68·15	75·29	59·43
0·8785	66·08	73·41	57·95	0·8735	68·19	75·33	59·46
0·8784	66·12	73·45	57·98	0·8734	68·23	75·37	59·49
0·8783	66·16	73·49	58·01	0·8733	68·28	75·41	59·52
0·8782	66·21	73·53	58·04	0·8732	68·32	75·44	59·55
0·8781	66·25	73·57	58·07	0·8731	68·36	75·48	59·58
0·8780	66·29	73·61	58·10	0·8730	68·40	75·52	59·61
0·8779	66·33	73·64	58·13	0·8729	68·45	75·56	59·64
0·8778	66·37	73·68	58·16	0·8728	68·49	75·60	59·67
0·8777	66·42	73·72	58·19	0·8727	68·53	75·63	59·70
0·8776	66·46	73·76	58·22	0·8726	68·57	75·67	59·73
0·8775	66·50	73·80	58·25	0·8725	68·61	75·71	59·76
0·8774	66·54	73·84	58·28	0·8724	68·66	75·75	59·79
0·8773	66·59	73·87	58·31	0·8723	68·70	75·78	59·82
0·8772	66·63	73·91	58·34	0·8722	68·74	75·82	59·85
0·8771	66·67	73·95	58·37	0·8721	68·78	75·86	59·88
0·8770	66·71	73·99	58·40	0·8720	68·82	75·90	59·91
0·8769	66·75	74·03	58·43	0·8719	68·87	75·93	59·94
0·8768	66·80	74·07	58·46	0·8718	68·91	75·97	59·97
0·8767	66·84	74·11	58·49	0·8717	68·95	76·01	60·00
0·8766	66·88	74·14	58·52	0·8716	68·99	76·05	60·03
0·8765	66·92	74·18	58·56	0·8715	69·03	76·09	60·06
0·8764	66·97	74·22	58·59	0·8714	69·08	76·12	60·09
0·8763	67·01	74·26	58·62	0·8713	69·12	76·16	60·12
0·8762	67·05	74·30	58·65	0·8712	69·16	76·20	60·15
0·8761	67·09	74·34	58·68	0·8711	69·20	76·24	60·18
0·8760	67·14	74·37	58·71	0·8710	69·24	76·27	60·21
0·8759	67·18	74·41	58·74	0·8709	69·29	76·31	60·24
0·8758	67·22	74·45	58·77	0·8708	69·33	76·35	60·26
0·8757	67·26	74·49	58·80	0·8707	69·37	76·39	60·29
0·8756	67·31	74·53	58·83	0·8706	69·41	76·42	60·32
0·8755	67·35	74·57	58·86	0·8705	69·45	76·46	60·35
0·8754	67·39	74·60	58·89	0·8704	69·50	76·50	60·38
0·8753	67·43	74·64	58·92	0·8703	69·54	76·54	60·41
0·8752	67·47	74·68	58·95	0·8702	69·58	76·57	60·44
0·8751	67·52	74·72	58·98	0·8701	69·62	76·61	60·47

Table 1 contd on p. 296

Table 1 (continued)

Specific gravity (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml
0·8700	69·66	76·65	60·50	0·8650	71·75	78·49	61·95
0·8699	69·71	76·68	60·53	0·8649	71·79	78·52	61·98
0·8698	69·75	76·72	60·56	0·8648	71·83	78·56	62·01
0·8697	69·79	76·76	60·59	0·8647	71·88	78·60	62·04
0·8696	69·83	76·80	60·62	0·8646	71·92	78·63	62·07
0·8695	69·87	76·83	60·65	0·8645	71·96	78·67	62·10
0·8694	69·92	76·87	60·68	0·8644	72·00	78·71	62·13
0·8693	69·96	76·91	60·71	0·8643	72·04	78·74	62·16
0·8692	70·00	76·94	60·74	0·8642	72·08	78·78	62·18
0·8691	70·04	76·98	60·77	0·8641	72·12	78·82	62·21
0·8690	70·08	77·02	60·79	0·8640	72·17	78·85	62·24
0·8689	70·12	77·06	60·82	0·8639	72·21	78·89	62·27
0·8688	70·17	77·09	60·85	0·8638	72·25	78·93	62·30
0·8687	70·21	77·13	60·88	0·8637	72·29	78·96	62·33
0·8686	70·25	77·17	60·91	0·8636	72·33	79·00	62·36
0·8685	70·29	77·20	60·94	0·8635	72·37	79·03	62·38
0·8684	70·33	77·24	60·97	0·8634	72·42	79·07	62·41
0·8683	70·38	77·28	61·00	0·8633	72·46	79·11	62·44
0·8682	70·42	77·32	61·03	0·8632	72·50	79·14	62·47
0·8681	70·46	77·35	61·06	0·8631	72·54	79·18	62·50
0·8680	70·50	77·39	61·09	0·8630	72·58	79·22	62·53
0·8679	70·54	77·43	61·12	0·8629	72·62	79·25	62·56
0·8678	70·58	77·46	61·15	0·8628	72·67	79·29	62·59
0·8677	70·63	77·50	61·17	0·8627	72·71	79·32	62·61
0·8676	70·67	77·54	61·20	0·8626	72·75	79·36	62·64
0·8675	70·71	77·57	61·23	0·8625	72·79	79·40	62·67
0·8674	70·75	77·61	61·26	0·8624	72·83	79·43	62·70
0·8673	70·79	77·65	61·29	0·8623	72·87	79·47	62·73
0·8672	70·84	77·68	61·32	0·8622	72·92	79·50	62·76
0·8671	70·88	77·72	61·35	0·8621	72·96	79·54	62·78
0·8670	70·92	77·76	61·38	0·8620	73·00	79·58	62·81
0·8669	70·96	77·79	61·41	0·8619	73·04	79·61	62·84
0·8668	71·00	77·83	61·44	0·8618	73·08	79·65	62·87
0·8667	71·04	77·87	61·46	0·8617	73·12	79·68	62·90
0·8666	71·09	77·90	61·49	0·8616	73·16	79·72	62·93
0·8665	71·13	77·94	61·52	0·8615	73·21	79·76	62·96
0·8664	71·17	77·98	61·55	0·8614	73·25	79·79	62·98
0·8663	71·21	78·01	61·58	0·8613	73·29	79·83	63·01
0·8662	71·25	78·05	61·61	0·8612	73·33	79·86	63·04
0·8661	71·29	78·09	61·64	0·8611	73·37	79·90	63·07
0·8660	71·33	78·12	61·67	0·8610	73·41	79·94	63·10
0·8659	71·38	78·16	61·70	0·8609	73·45	79·97	63·12
0·8658	71·42	78·20	61·72	0·8608	73·50	80·01	63·15
0·8657	71·46	78·23	61·75	0·8607	73·54	80·04	63·18
0·8656	71·50	78·27	61·78	0·8606	73·58	80·08	63·21
0·8655	71·54	78·31	61·81	0·8605	73·62	80·12	63·24
0·8654	71·58	78·34	61·84	0·8604	73·66	80·15	63·27
0·8653	71·63	78·38	61·87	0·8603	73·70	80·19	63·29
0·8652	71·67	78·42	61·90	0·8602	73·74	80·22	63·32
0·8651	71·71	78·45	61·93	0·8601	73·79	80·26	63·35

Table 1 contd on p. 297

Table 1 (continued)

Specific gravity (20/20)	*Per cent by weight*	*by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent by weight*	*by volume*	*G in* 100ml
0·8600	73·83	80·29	63·38	0·8550	75·89	82·06	64·77
0·8599	73·87	80·33	63·41	0·8549	75·93	82·09	64·80
0·8598	73·91	80·36	63·44	0·8548	75·97	82·13	64·83
0·8597	73·95	80·40	63·46	0·8547	76·01	82·16	64·85
0·8596	73·99	80·44	63·49	0·8546	76·05	82·20	64·88
0·8595	74·03	80·47	63·52	0·8545	76·10	82·23	64·91
0·8594	74·07	80·51	63·55	0·8544	76·14	82·27	64·94
0·8593	74·12	80·54	63·58	0·8543	76·18	82·30	64·96
0·8592	74·16	80·58	63·60	0·8542	76·22	82·34	64·99
0·8591	74·20	80·61	63·63	0·8541	76·26	82·37	65·02
0·8590	74·24	80·65	63·66	0·8540	76·30	82·41	65·05
0·8589	74·28	80·68	63·69	0·8539	76·34	82·44	65·07
0·8588	74·32	80·72	63·72	0·8538	76·38	82·48	65·10
0·8587	74·36	80·76	63·74	0·8537	76·42	82·51	65·13
0·8586	74·41	80·79	63·77	0·8536	76·47	82·54	65·16
0·8585	74·45	80·83	63·80	0·8535	76·51	82·58	65·18
0·8584	74·49	80·86	63·83	0·8534	76·55	82·61	65·21
0·8583	74·53	80·90	63·85	0·8533	76·59	82·65	65·24
0·8582	74·57	80·93	63·88	0·8532	76·63	82·68	65·27
0·8581	74·61	80·97	63·91	0·8531	76·67	82·72	65·29
0·8580	74·65	81·00	63·94	0·8530	76·71	82·75	65·32
0·8579	74·69	81·04	63·97	0·8529	76·75	82·79	65·35
0·8578	74·73	81·07	63·99	0·8528	76·79	82·82	65·37
0·8577	74·78	81·11	64·02	0·8527	76·84	82·86	65·40
0·8576	74·82	81·14	64·05	0·8526	76·88	82·89	65·43
0·8575	74·86	81·18	64·08	0·8525	76·92	82·92	65·46
0·8574	74·90	81·21	64·11	0·8524	76·96	82·96	65·48
0·8573	74·94	81·25	64·13	0·8523	77·00	82·99	65·51
0·8572	74·98	81·28	64·16	0·8522	77·04	83·03	65·54
0·8571	75·02	81·32	64·19	0·8521	77·08	83·06	65·56
0·8570	75·06	81·35	64·22	0·8520	77·12	83·10	65·59
0·8569	75·11	81·39	64·24	0·8519	77·16	83·13	65·62
0·8568	75·15	81·43	64·27	0·8518	77·20	83·17	65·65
0·8567	75·19	81·46	64·30	0·8517	77·25	83·20	65·67
0·8566	75·23	81·50	64·33	0·8516	77·29	83·23	65·70
0·8565	75·27	81·53	64·36	0·8515	77·33	83·27	65·73
0·8564	75·31	81·57	64·38	0·8514	77·37	83·30	65·75
0·8563	75·35	81·60	64·41	0·8513	77·41	83·34	65·78
0·8562	75·40	81·64	64·44	0·8512	77·45	83·37	65·81
0·8561	75·44	81·67	64·47	0·8511	77·49	83·41	65·84
0·8560	75·48	81·71	64·49	0·8510	77·53	83·44	65·86
0·8559	75·52	81·74	64·52	0·8509	77·57	83·47	65·89
0·8558	75·56	81·78	64·55	0·8508	77·61	83·51	65·92
0·8557	75·60	81·81	64·58	0·8507	77·65	83·54	65·94
0·8556	75·64	81·85	64·61	0·8506	77·70	83·58	65·97
0·8555	75·68	81·88	64·63	0·8505	77·74	83·61	66·00
0·8554	75·73	81·92	64·66	0·8504	77·78	83·65	66·02
0·8553	75·77	81·95	64·69	0·8503	77·82	83·68	66·05
0·8552	75·81	81·99	64·72	0·8502	77·86	83·71	66·08
0·8551	75·85	82·02	64·74	0·8501	77·90	83·75	66·11

Table 1 contd on p. 298

Table 1 (continued)

Specific gravity (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml
0·8500	77·94	83·78	66·13	0·8450	79·97	85·46	67·46
0·8499	77·98	83·82	66·16	0·8449	80·01	85·49	67·48
0·8498	78·02	83·85	66·19	0·8448	80·05	85·53	67·51
0·8497	78·06	83·88	66·21	0·8447	80·10	85·56	67·54
0·8496	78·10	83·92	66·24	0·8446	80·14	85·59	67·56
0·8495	78·14	83·95	66·27	0·8445	80·18	85·63	67·59
0·8494	78·19	83·99	66·29	0·8444	80·22	85·66	67·61
0·8493	78·23	84·02	66·32	0·8443	80·26	85·69	67·64
0·8492	78·27	84·05	66·35	0·8442	80·30	85·73	67·67
0·8491	78·31	84·09	66·37	0·8441	80·34	85·76	67·69
0·8490	78·35	84·12	66·40	0·8440	80·38	85·79	67·72
0·8489	78·39	84·15	66·43	0·8439	80·42	85·82	67·74
0·8488	78·43	84·19	66·45	0·8438	80·46	85·86	67·77
0·8487	78·47	84·22	66·48	0·8437	80·50	85·89	67·80
0·8486	78·51	84·26	66·51	0·8436	80·54	85·92	67·82
0·8485	78·55	84·29	66·53	0·8435	80·58	85·95	67·85
0·8484	78·59	84·32	66·56	0·8434	80·62	85·99	67·87
0·8483	78·63	84·36	66·59	0·8433	80·66	86·02	67·90
0·8482	78·67	84·39	66·61	0·8432	80·70	86·05	67·92
0·8481	78·71	84·42	66·64	0·8431	80·74	86·08	67·95
0·8480	78·76	84·46	66·67	0·8430	80·78	86·12	67·98
0·8479	78·80	84·49	66·69	0·8429	80·82	86·15	68·00
0·8478	78·84	84·53	66·72	0·8428	80·86	86·18	68·03
0·8477	78·88	84·56	66·75	0·8427	80·90	86·22	68·05
0·8476	78·92	84·59	66·77	0·8426	80·94	86·25	68·08
0·8475	78·96	84·63	66·80	0·8425	80·98	86·28	68·11
0·8474	79·00	84·66	66·83	0·8424	81·02	86·31	68·13
0·8473	79·04	84·69	66·85	0·8423	81·06	86·35	68·16
0·8472	79·08	84·73	66·88	0·8422	81·10	86·38	68·18
0·8471	79·12	84·76	66·91	0·8421	81·14	86·41	68·21
0·8470	79·16	84·79	66·93	0·8420	81·18	86·44	68·23
0·8469	79·20	84·83	66·96	0·8419	81·22	86·48	68·26
0·8468	79·24	84·86	66·99	0·8418	81·26	86·51	68·29
0·8467	79·28	84·90	67·01	0·8417	81·30	86·54	68·31
0·8466	79·33	84·93	67·04	0·8416	81·34	86·57	68·34
0·8465	79·37	84·96	67·06	0·8415	81·38	86·61	68·36
0·8464	79·41	85·00	67·09	0·8414	81·42	86·64	68·39
0·8463	79·45	85·03	67·12	0·8413	81·46	86·67	68·41
0·8462	79·49	85·06	67·14	0·8412	81·50	86·70	68·44
0·8461	79·53	85·10	67·17	0·8411	81·54	86·74	68·47
0·8460	79·57	85·13	67·20	0·8410	81·58	86·77	68·49
0·8459	79·61	85·16	67·22	0·8409	81·62	86·80	68·52
0·8458	79·65	85·20	67·25	0·8408	81·66	86·83	68·54
0·8457	79·69	85·23	67·28	0·8407	81·71	86·87	68·57
0·8456	79·73	85·26	67·30	0·8406	81·75	86·90	68·59
0·8455	79·77	85·30	67·33	0·8405	81·79	86·93	68·62
0·8454	79·81	85·33	67·35	0·8404	81·83	86·96	68·64
0·8453	79·85	85·36	67·38	0·8403	81·87	87·00	68·67
0·8452	79·89	85·40	67·41	0·8402	81·91	87·03	68·70
0·8451	79·93	85·43	67·43	0·8401	81·95	87·06	68·72

Table 1 contd on p. 299

Table 1 (continued)

Specific gravity (20/20)	*Per cent* by weight	by volume	*G in* 100ml	*Specific gravity* (20/20)	*Per cent* by weight	by volume	*G in* 100ml
0·8400	81·99	87·09	68·75	0·8350	83·98	88·68	70·00
0·8399	82·03	87·13	68·77	0·8349	84·02	88·72	70·03
0·8398	82·07	87·16	68·80	0·8348	84·06	88·75	70·05
0·8397	82·11	87·19	68·82	0·8347	84·10	88·78	70·08
0·8396	82·15	87·22	68·85	0·8346	84·14	88·81	70·10
0·8395	82·19	87·26	68·87	0·8345	84·18	88·84	70·12
0·8394	82·23	87·29	68·90	0·8344	84·22	88·87	70·15
0·8393	82·27	87·32	68·93	0·8343	84·26	88·90	70·17
0·8392	82·31	87·35	68·95	0·8342	84·30	88·93	70·20
0·8391	82·35	87·38	68·98	0·8341	84·34	88·96	70·22
0·8390	82·39	87·42	69·00	0·8340	84·38	89·00	70·25
0·8389	82·43	87·45	69·03	0·8339	84·42	89·03	70·27
0·8388	82·47	87·48	69·05	0·8338	84·46	89·06	70·30
0·8387	82·51	87·51	69·08	0·8337	84·50	89·09	70·32
0·8386	82·55	87·55	69·10	0·8336	84·54	89·12	70·35
0·8385	82·59	87·58	69·13	0·8335	84·58	89·15	70·37
0·8384	82·63	87·61	69·15	0·8334	84·62	89·18	70·39
0·8383	82·67	87·64	69·18	0·8333	84·66	89·21	70·42
0·8382	82·71	87·67	69·20	0·8332	84·69	89·24	70·44
0·8381	82·75	87·71	69·23	0·8331	84·73	89·27	70·47
0·8380	82·79	87·74	69·25	0·8330	84·77	89·30	70·49
0·8379	82·83	87·77	69·28	0·8329	84·81	89·33	70·52
0·8378	82·87	87·80	69·30	0·8328	84·85	89·37	70·54
0·8377	82·91	87·83	69·33	0·8327	84·89	89·40	70·56
0·8376	82·95	87·86	69·36	0·8326	84·93	89·43	70·59
0·8375	82·99	87·90	69·38	0·8325	84·97	89·46	70·61
0·8374	83·03	87·93	69·41	0·8324	85·01	89·49	70·64
0·8373	83·07	87·96	69·43	0·8323	85·05	89·52	70·66
0·8372	83·11	87·99	69·46	0·8322	85·09	89·55	70·68
0·8371	83·15	88·02	69·48	0·8321	85·13	89·58	70·71
0·8370	83·19	88·06	69·51	0·8320	85·17	89·61	70·73
0·8369	83·23	88·09	69·53	0·8319	85·21	89·64	70·76
0·8368	83·27	88·12	69·56	0·8318	85·24	89·67	70·78
0·8367	83·31	88·15	69·58	0·8317	85·28	89·70	70·81
0·8366	83·35	88·18	69·61	0·8316	85·32	89·73	70·83
0·8365	83·39	88·21	69·63	0·8315	85·36	89·76	70·85
0·8364	83·43	88·24	69·66	0·8314	85·40	89·79	70·88
0·8363	83·47	88·28	69·68	0·8313	85·44	89·82	70·90
0·8362	83·51	88·31	69·70	0·8312	85·48	89·85	70·93
0·8361	83·55	88·34	69·73	0·8311	85·52	89·88	70·95
0·8360	83·59	88·37	69·75	0·8310	85·56	89·91	70·97
0·8359	83·63	88·40	69·78	0·8309	85·60	89·94	71·00
0·8358	83·67	88·43	69·80	0·8308	85·64	89·97	71·02
0·8357	83·71	88·47	69·83	0·8307	85·68	90·00	71·04
0·8356	83·75	88·50	69·85	0·8306	85·71	90·04	71·07
0·8355	83·79	88·53	69·88	0·8305	85·75	90·07	71·09
0·8354	83·82	88·56	69·90	0·8304	85·79	90·10	71·12
0·8353	83·86	88·59	69·93	0·8303	85·83	90·13	71·14
0·8352	83·90	88·62	69·95	0·8302	85·87	90·16	71·16
0·8351	83·94	88·65	69·98	0·8301	85·91	90·19	71·19

Table 1 contd on p. 300

Table 1 (continued)

Specific gravity (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent* *by weight*	*by volume*	*G in* 100ml
0·8300	85·95	90·22	71·21	0·8250	87·88	91·69	72·37
0·8299	85·99	90·25	71·24	0·8249	87·92	91·72	72·40
0·8298	86·03	90·28	71·26	0·8248	87·96	91·75	72·42
0·8297	86·07	90·31	71·28	0·8247	88·00	91·78	72·44
0·8296	86·10	90·34	71·31	0·8246	88·03	91·80	72·46
0·8295	86·14	90·37	71·33	0·8245	88·07	91·83	72·49
0·8294	86·18	90·40	71·35	0·8244	88·11	91·86	72·51
0·8293	86·22	90·43	71·38	0·8243	88·15	91·89	72·53
0·8292	86·26	90·46	71·40	0·8242	88·19	91·92	72·56
0·8291	86·30	90·49	71·42	0·8241	88·23	91·95	72·58
0·8290	86·34	90·52	71·45	0·8240	88·26	91·98	72·60
0·8289	86·38	90·55	71·47	0·8239	88·30	92·01	72·62
0·8288	86·42	90·58	71·50	0·8238	88·34	92·03	72·65
0·8287	86·46	90·61	71·52	0·8237	88·38	92·06	72·67
0·8286	86·49	90·64	71·54	0·8236	88·42	92·09	72·69
0·8285	86·53	90·67	71·57	0·8235	88·46	92·12	72·71
0·8284	86·57	90·70	71·59	0·8234	88·49	92·15	72·74
0·8283	86·61	90·73	71·61	0·8233	88·53	92·18	72·76
0·8282	86·65	90·75	71·64	0·8232	88·57	92·21	72·78
0·8281	86·69	90·78	71·66	0·8231	88·61	92·24	72·81
0·8280	86·73	90·81	71·68	0·8230	88·65	92·26	72·83
0·8279	86·77	90·84	71·71	0·8229	88·69	92·29	72·85
0·8278	86·80	90·87	71·73	0·8228	88·72	92·32	72·87
0·8277	86·84	90·90	71·75	0·8227	88·76	92·35	72·90
0·8276	86·88	90·93	71·78	0·8226	88·80	92·38	72·92
0·8275	86·92	90·96	71·80	0·8225	88·84	92·41	72·94
0·8274	86·96	90·99	71·82	0·8224	88·88	92·44	72·96
0·8273	87·00	91·02	71·85	0·8223	88·91	92·46	72·99
0·8272	87·04	91·05	71·87	0·8222	88·95	92·49	73·01
0·8271	87·07	91·08	71·89	0·8221	88·99	92·52	73·03
0·8270	87·11	91·11	71·92	0·8220	89·03	92·55	73·05
0·8269	87·15	91·14	71·94	0·8219	89·07	92·58	73·07
0·8268	87·19	91·17	71·96	0·8218	89·10	92·60	73·10
0·8267	87·23	91·20	71·98	0·8217	89·14	92·63	73·12
0·8266	87·27	91·22	72·01	0·8216	89·18	92·66	73·14
0·8265	87·31	91·25	72·03	0·8215	89·22	92·69	73·16
0·8264	87·34	91·28	72·05	0·8214	89·26	92·72	73·18
0·8263	87·38	91·31	72·08	0·8213	89·29	92·74	73·21
0·8262	87·42	91·34	72·10	0·8212	89·33	92·77	73·23
0·8261	87·46	91·37	72·12	0·8211	89·37	92·80	73·25
0·8260	87·50	91·40	72·15	0·8210	89·41	92·83	73·27
0·8259	87·54	91·43	72·17	0·8209	89·44	92·86	73·29
0·8258	87·57	91·46	72·19	0·8208	89·48	92·88	73·32
0·8257	87·61	91·49	72·21	0·8207	89·52	92·91	73·34
0·8256	87·65	91·51	72·24	0·8206	89·56	92·94	73·36
0·8255	87·69	91·54	72·26	0·8205	89·59	92·97	73·38
0·8254	87·73	91·57	72·28	0·8204	89·63	92·99	73·40
0·8253	87·77	91·60	72·30	0·8203	89·67	93·02	73·43
0·8252	87·80	91·63	72·33	0·8202	89·71	93·05	73·45
0·8251	87·84	91·66	72·35	0·8201	89·74	93·08	73·47

Table 1 contd on p. 301

Table 1 (continued)

Specific gravity (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml
0·8200	89·78	93·10	73·49	0·8150	91·64	94·45	74·55
0·8199	89·82	93·13	73·51	0·8149	91·67	94·48	74·57
0·8198	89·86	93·16	73·53	0·8148	91·71	94·50	74·59
0·8197	89·90	93·19	73·56	0·8147	91·75	94·53	74·61
0·8196	89·93	93·21	73·58	0·8146	91·78	94·55	74·64
0·8195	89·97	93·24	73·60	0·8145	91·82	94·58	74·66
0·8194	90·01	93·27	73·62	0·8144	91·86	94·61	74·68
0·8193	90·05	93·30	73·64	0·8143	91·89	94·63	74·70
0·8192	90·08	93·32	73·67	0·8142	91·93	94·66	74·72
0·8191	90·12	93·35	73·69	0·8141	91·97	94·68	74·74
0·8190	90·16	93·38	73·71	0·8140	92·00	94·71	74·76
0·8189	90·19	93·41	73·73	0·8139	92·04	94·74	74·78
0·8188	90·23	93·43	73·75	0·8138	92·08	94·76	74·80
0·8187	90·27	93·46	73·77	0·8137	92·11	94·79	74·82
0·8186	90·31	93·49	73·79	0·8136	92·15	94·81	74·84
0·8185	90·34	93·52	73·82	0·8135	92·19	94·84	74·86
0·8184	90·38	93·54	73·84	0·8134	92·22	94·87	74·88
0·8183	90·42	93·57	73·86	0·8133	92·26	94·89	74·90
0·8182	90·46	93·60	73·88	0·8132	92·30	94·92	74·92
0·8181	90·49	93·62	73·90	0·8131	92·33	94·94	74·94
0·8180	90·53	93·65	73·92	0·8130	92·37	94·97	74·96
0·8179	90·57	93·68	73·94	0·8129	92·41	95·00	74·98
0·8178	90·61	93·71	73·97	0·8128	92·44	95·02	75·00
0·8177	90·64	93·73	73·99	0·8127	92·48	95·05	75·02
0·8176	90·68	93·76	74·01	0·8126	92·52	95·07	75·05
0·8175	90·72	93·79	74·03	0·8125	92·55	95·10	75·07
0·8174	90·75	93·81	74·05	0·8124	92·59	95·13	75·09
0·8173	90·79	93·84	74·07	0·8123	92·63	95·15	75·11
0·8172	90·83	93·87	74·09	0·8122	92·66	95·18	75·13
0·8171	90·87	93·89	74·11	0·8121	92·70	95·20	75·15
0·8170	90·90	93·92	74·14	0·8120	92·73	95·23	75·17
0·8169	90·94	93·95	74·16	0·8119	92·77	95·25	75·19
0·8168	90·98	93·97	74·18	0·8118	92·81	95·28	75·21
0·8167	91·01	94·00	74·20	0·8117	92·84	95·30	75·23
0·8166	91·05	94·03	74·22	0·8116	92·88	95·33	75·25
0·8165	91·09	94·05	74·24	0·8115	92·92	95·35	75·27
0·8164	91·12	94·08	74·26	0·8114	92·95	95·38	75·29
0·8163	91·16	94·11	74·28	0·8113	92·99	95·41	75·31
0·8162	91·20	94·13	74·30	0·8112	93·02	95·43	75·33
0·8161	91·23	94·16	74·32	0·8111	93·06	95·46	75·35
0·8160	91·27	94·19	74·35	0·8110	93·10	95·48	75·37
0·8159	91·31	94·21	74·37	0·8109	93·13	95·51	75·39
0·8158	91·34	94·24	74·39	0·8108	93·17	95·53	75·41
0·8157	91·38	94·27	74·41	0·8107	93·20	95·56	75·43
0·8156	91·42	94·29	74·43	0·8106	93·24	95·58	75·45
0·8155	91·45	94·32	74·45	0·8105	93·28	95·61	75·47
0·8154	91·49	94·34	74·47	0·8104	93·31	95·63	75·49
0·8153	91·53	94·37	74·49	0·8103	93·35	95·66	75·51
0·8152	91·56	94·40	74·51	0·8102	93·38	95·68	75·53
0·8151	91·60	94·42	74·53	0·8101	93·42	95·71	75·55

Table 1 contd on p. 302

Table 1 (continued)

Specific gravity (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml
0·8100	93·46	95·73	75·57	0·8050	95·23	96·95	76·53
0·8099	93·49	95·76	75·59	0·8049	95·27	96·98	76·55
0·8098	93·53	95·78	75·60	0·8048	95·30	97·00	76·57
0·8097	93·56	95·81	75·62	0·8047	95·34	97·02	76·58
0·8096	93·60	95·83	75·64	0·8046	95·37	97·05	76·60
0·8095	93·63	95·86	75·66	0·8045	95·41	97·07	76·62
0·8094	93·67	95·88	75·68	0·8044	95·44	97·09	76·64
0·8093	93·71	95·91	75·70	0·8043	95·48	97·12	76·66
0·8092	93·74	95·93	75·72	0·8042	95·51	97·14	76·68
0·8091	93·78	95·96	75·74	0·8041	95·55	97·16	76·69
0·8090	93·81	95·98	75·76	0·8040	95·58	97·19	76·71
0·8089	93·85	96·01	75·78	0·8039	95·62	97·21	76·73
0·8088	93·89	96·03	75·80	0·8038	95·65	97·23	76·75
0·8087	93·92	96·05	75·82	0·8037	95·69	97·26	76·77
0·8086	93·96	96·08	75·84	0·8036	95·72	97·28	76·79
0·8085	93·99	96·10	75·86	0·8035	95·76	97·30	76·81
0·8084	94·03	96·13	75·88	0·8034	95·79	97·33	76·82
0·8083	94·06	96·15	75·90	0·8033	95·83	97·35	76·84
0·8082	94·10	96·18	75·92	0·8032	95·86	97·37	76·86
0·8081	94·14	96·20	75·94	0·8031	95·90	97·40	76·88
0·8080	94·17	96·23	75·96	0·8030	95·93	97·42	76·90
0·8079	94·21	96·25	75·98	0·8029	95·97	97·44	76·91
0·8078	94·24	96·28	75·99	0·8028	96·00	97·46	76·93
0·8077	94·28	96·30	76·01	0·8027	96·03	97·49	76·95
0·8076	94·31	96·33	76·03	0·8026	96·07	97·51	76·97
0·8075	94·35	96·35	76·05	0·8025	96·10	97·53	76·99
0·8074	94·39	96·37	76·07	0·8024	96·14	97·56	77·00
0·8073	94·42	96·40	76·09	0·8023	96·17	97·58	77·02
0·8072	94·46	96·42	76·11	0·8022	96·21	97·60	77·04
0·8071	94·49	96·45	76·13	0·8021	96·24	97·62	77·06
0·8070	94·53	96·47	76·15	0·8020	96·28	97·65	77·08
0·8069	94·56	96·50	76·17	0·8019	96·31	97·67	77·09
0·8068	94·60	96·52	76·19	0·8018	96·34	97·69	77·11
0·8067	94·63	96·54	76·21	0·8017	96·38	97·71	77·13
0·8066	94·67	96·57	76·23	0·8016	96·41	97·74	77·15
0·8065	94·71	96·59	76·24	0·8015	96·45	97·76	77·17
0·8064	94·74	96·62	76·26	0·8014	96·48	97·78	77·18
0·8063	94·78	96·64	76·28	0·8013	96·52	97·81	77·20
0·8062	94·81	96·67	76·30	0·8012	96·55	97·83	77·22
0·8061	94·85	96·69	76·32	0·8011	96·58	97·85	77·24
0·8060	94·88	96·71	76·34	0·8010	96·62	97·87	77·25
0·8059	94·92	96·74	76·36	0·8009	96·65	97·89	77·27
0·8058	94·95	96·76	76·38	0·8008	96·69	97·92	77·29
0·8057	94·99	96·79	76·40	0·8007	96·72	97·94	77·31
0·8056	95·02	96·81	76·42	0·8006	96·75	97·96	77·32
0·8055	95·06	96·83	76·43	0·8005	96·79	97·98	77·34
0·8054	95·09	96·86	76·45	0·8004	96·82	98·01	77·36
0·9053	95·13	96·88	76·47	0·8003	96·86	98·03	77·38
0·8052	95·16	96·90	76·49	0·8002	96·89	98·05	77·39
0·8051	95·20	96·93	76·51	0·8001	96·92	98·07	77·41

Table 1 contd on p. 303

Table 1 (continued)

Specific gravity (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml	*Specific gravity* (20/20)	*Per cent by weight*	*Per cent by volume*	*G in* 100ml
0·8000	96·96	98·09	77·43	0·7950	98·62	99·15	78·26
0·7999	96·99	98·12	77·45	0·7949	98·65	99·17	78·28
0·7998	97·03	98·14	77·46	0·7948	98·68	99·19	78·30
0·7997	97·06	98·16	77·48	0·7947	98·72	99·21	78·31
0·7996	97·09	98·18	77·50	0·7946	98·75	99·23	78·33
0·7995	97·13	98·20	77·52	0·7945	98·78	99·25	78·34
0·7994	97·16	98·22	77·53	0·7944	98·82	99·27	78·36
0·7993	97·19	98·25	77·55	0·7943	98·85	99·29	78·38
0·7992	97·23	98·27	77·57	0·7942	98·88	99·31	78·39
0·7991	97·26	98·29	77·58	0·7941	98·91	99·33	78·41
0·7990	97·29	98·31	77·60	0·7940	98·95	99·35	78·42
0·7989	97·33	98·33	77·62	0·7939	98·98	99·37	78·44
0·7988	97·36	98·35	77·63	0·7938	99·01	99·39	78·46
0·7987	97·39	98·38	77·65	0·7937	99·04	99·41	78·47
0·7986	97·43	98·40	77·67	0·7936	99·08	99·43	78·49
0·7985	97·46	98·42	77·69	0·7935	99·11	99·45	78·50
0·7984	97·50	98·44	77·70	0·7934	99·14	99·48	78·52
0·7983	97·53	98·46	77·72	0·7933	99·17	99·50	78·54
0·7982	97·56	98·48	77·74	0·7932	99·21	99·52	78·55
0·7981	97·59	98·50	77·75	0·7931	99·24	99·54	78·57
0·7980	97·63	98·52	77·77	0·7930	99·27	99·56	78·58
0·7979	97·66	98·55	77·79	0·7929	99·30	99·58	78·60
0·7978	97·69	98·57	77·80	0·7928	99·34	99·59	78·61
0·7977	97·73	98·59	77·82	0·7927	99·37	99·61	78·63
0·7976	97·76	98·61	77·84	0·7926	99·40	99·63	78·65
0·7975	97·79	98·63	77·85	0·7925	99·43	99·65	78·66
0·7974	97·83	98·65	77·87	0·7924	99·47	99·67	78·68
0·7973	97·86	98·67	77·89	0·7923	99·50	99·69	78·69
0·7972	97·89	98·69	77·90	0·7922	99·53	99·71	78·71
0·7971	97·93	98·71	77·92	0·7921	99·56	99·73	78·72
0·7970	97·96	98·74	77·94	0·7920	99·59	99·75	78·74
0·7969	97·99	98·76	77·95	0·7919	99·63	99·77	78·75
0·7968	98·03	98·78	77·97	0·7918	99·66	99·79	78·77
0·7967	98·06	98·80	77·99	0·7917	99·69	99·81	78·79
0·7966	98·09	98·82	78·00	0·7916	99·72	99·83	78·80
0·7965	98·13	98·84	78·02	0·7915	99·76	99·85	78·82
0·7964	98·16	98·86	78·04	0·7914	99·79	99·87	78·83
0·7963	98·19	98·88	78·05	0·7913	99·82	99·89	78·85
0·7962	98·22	98·90	78·07	0·7912	99·85	99·91	78·86
0·7961	98·26	98·92	78·08	0·7911	99·88	99·93	78·88
0·7960	98·29	98·94	78·10	0·7910	99·92	99·95	78·89
0·7959	98·32	98·97	78·12	0·7909	99·95	99·97	78·91
0·7958	98·36	98·99	78·13	0·7908	99·98	99·99	78·92
0·7957	98·39	99·01	78·15	0·79074	100·00	100·00	78·93
0·7956	98·42	99·03	78·17				
0·7955	98·46	99·05	78·18				
0·7954	98·49	99·07	78·20				
0·7953	98·52	99·09	78·22				
0·7952	98·55	99·11	78·23				
0·7951	98·59	99·13	78·25				

Table 2. Corrections (Δ_g) for the buoyant effect of air to the weight of a glass pycnometer

Temp. (°C)	*Air pressure* (mmHg)						
	680	690	700	710	720	730	740
15	0·000360	0·000365	0·000371	0·000376	0·000381	0·000387	0·000392
16	0·000359	0·000364	0·000369	0·000375	0·000380	0·000385	0·000391
17	0·000358	0·000363	0·000368	0·000373	0·000379	0·000384	0·000389
18	0·000356	0·000361	0·000366	0·000372	0·000377	0·000382	0·000388
19	0·000355	0·000360	0·000365	0·000370	0·000376	0·000381	0·000386
20	0·000354	0·000359	0·000364	0·000369	0·000374	0·000380	0·000385
21	0·000352	0·000357	0·000362	0·000368	0·000373	0·000378	0·000383
22	0·000351	0·000356	0·000361	0·000366	0·000372	0·000377	0·000382
23	0·000350	0·000355	0·000360	0·000365	0·000370	0·000375	0·000381
24	0·000348	0·000353	0·000359	0·000364	0·000369	0·000374	0·000379
25	0·000347	0·000352	0·000357	0·000362	0·000367	0·000373	0·000378
26	0·000346	0·000351	0·000356	0·000361	0·000366	0·000371	0·000376
27	0·000344	0·000349	0·000355	0·000360	0·000365	0·000370	0·000375
28	0·000343	0·000348	0·000353	0·000358	0·000363	0·000368	0·000373
29	0·000342	0·000347	0·000352	0·000357	0·000362	0·000367	0·000372
30	0·000340	0·000345	0·000351	0·000356	0·000361	0·000366	0·000371

	750	760	770	780	790	800
15	0·000397	0·000403	0·000408	0·000413	0·000419	0·000424
16	0·000396	0·000401	0·000406	0·000412	0·000417	0·000422
17	0·000394	0·000400	0·000405	0·000410	0·000416	0·000421
18	0·000393	0·000398	0·000403	0·000409	0·000414	0·000419
19	0·000392	0·000397	0·000402	0·000407	0·000412	0·000418
20	0·000390	0·000395	0·000400	0·000406	0·000411	0·000416
21	0·000389	0·000394	0·000399	0·000404	0·000409	0·000415
22	0·000387	0·000392	0·000397	0·000403	0·000408	0·000413
23	0·000386	0·000391	0·000396	0·000401	0·000406	0·000412
24	0·000384	0·000390	0·000394	0·000400	0·000405	0·000410
25	0·000383	0·000388	0·000393	0·000398	0·000403	0·000409
26	0·000381	0·000387	0·000392	0·000397	0·000402	0·000407
27	0·000380	0·000385	0·000390	0·000395	0·000400	0·000405
28	0·000379	0·000384	0·000389	0·000394	0·000399	0·000404
29	0·000377	0·000382	0·000387	0·000393	0·000397	0·000402
30	0·000376	0·000381	0·000386	0·000391	0·000396	0·000401

Table 3. Corrections ($\triangle_w$) for the buoyant effect of air to the weight of water in the pycnometer

Temp. (°C)	*Air pressure* (mmHg)						
	680	690	700	710	720	730	740
15	0·000966	0·000980	0·000994	0·001008	0·001022	0·001037	0·001051
16	0·000962	0·000976	0·000991	0·001005	0·001019	0·001033	0·001047
17	0·000959	0·000973	0·000987	0·001001	0·001015	0·001030	0·001044
18	0·000955	0·000969	0·000983	0·000997	0·001011	0·001025	0·001039
19	0·000952	0·000965	0·000979	0·000993	0·001007	0·001022	0·001036
20	0·000948	0·000961	0·000976	0·000990	0·001004	0·001018	0·001032
21	0·000945	0·000958	0·000972	0·000986	0·001000	0·001014	0·001028
22	0·000941	0·000954	0·000969	0·000983	0·000997	0·001010	0·001024
23	0·000938	0·000951	0·000965	0·000979	0·000992	0·001007	0·001021
24	0·000934	0·000947	0·000961	0·000976	0·000989	0·001003	0·001016
25	0·000930	0·000944	0·000958	0·000971	0·000985	0·000999	0·001013
26	0·000927	0·000940	0·000954	0·000968	0·000982	0·000995	0·001009
27	0·000923	0·000937	0·000951	0·000964	0·000978	0·000992	0·001006
28	0·000920	0·000933	0·000947	0·000961	0·000974	0·000988	0·001001
29	0·000916	0·000930	0·000944	0·000957	0·000970	0·000984	0·000998
30	0·000913	0·000926	0·000940	0·000953	0·000967	0·000981	0·000994

	750	760	770	780	790	800
15	0·001065	0·001080	0·001094	0·001108	0·001122	0·001137
16	0·001061	0·001076	0·001090	0·001104	0·001118	0·001132
17	0·001058	0·001072	0·001086	0·001100	0·001115	0·001129
18	0·001053	0·001068	0·001082	0·001096	0·001110	0·001124
19	0·001050	0·001064	0·001078	0·001092	0·001106	0·001120
20	0·001045	0·001060	0·001074	0·001088	0·001102	0·001116
21	0·001042	0·001056	0·001070	0·001084	0·001098	0·001112
22	0·001038	0·001052	0·001066	0·001080	0·001094	0·001107
23	0·001034	0·001048	0·001062	0·001076	0·001090	0·001104
24	0·001030	0·001045	0·001058	0·001072	0·001086	0·001099
25	0·001027	0·001040	0·001054	0·001068	0·001082	0·001096
26	0·001022	0·001037	0·001050	0·001064	0·001078	0·001092
27	0·001019	0·001033	0·001046	0·001061	0·001074	0·001087
28	0·001015	0·001029	0·001043	0·001056	0·001069	0·001084
29	0·001011	0·001025	0·001038	0·001053	0·001066	0·001079
30	0·001007	0·001021	0·001035	0·001048	0·001061	0·001076

Table 4. Density of air at a relative humidity of 50% and at various temperatures, g/ml

Temp. (°C)	*Air pressure* (mmHg) 680	690	700	710	720	730	740
15	0·001093	0·001109	0·001125	0·001141	0·001157	0·001173	0·001189
16	0·001089	0·001105	0·001121	0·001137	0·001153	0·001169	0·001185
17	0·001085	0·001101	0·001117	0·001133	0·001149	0·001165	0·001181
18	0·001081	0·001096	0·001112	0·001128	0·001144	0·001160	0·001176
19	0·001077	0·001092	0·001108	0·001124	0·001140	0·001156	0·001172
20	0·001073	0·001088	0·001104	0·001120	0·001136	0·001152	0·001168
21	0·001069	0·001084	0·001100	0·001116	0·001132	0·001147	0·001163
22	0·001065	0·001080	0·001096	0·001112	0·001128	0·001143	0·001159
23	0·001061	0·001076	0·001092	0·001108	0·001123	0·001139	0·001155
24	0·001057	0·001072	0·001088	0·001104	0·001119	0·001135	0·001150
25	0·001053	0·001068	0·001084	0·001099	0·001115	0·001131	0·001146
26	0·001049	0·001064	0·001080	0·001095	0·001111	0·001126	0·001142
27	0·001045	0·001060	0·001076	0·001091	0·001107	0·001122	0·001138
28	0·001041	0·001056	0·001072	0·001087	0·001102	0·001118	0·001133
29	0·001037	0·001052	0·001068	0·001083	0·001098	0·001114	0·001129
30	0·001033	0·001048	0·001064	0·001079	0·001094	0·001110	0·001125

	750	760	770	780	790	800
15	0·001205	0·001222	0·001238	0·001254	0·001270	0·001286
16	0·001201	0·001217	0·001233	0·001249	0·001265	0·001281
17	0·001197	0·001213	0·001229	0·001245	0·001261	0·001277
18	0·001192	0·001208	0·001224	0·001240	0·001256	0·001272
19	0·001188	0·001204	0·001220	0·001236	0·001251	0·001267
20	0·001183	0·001199	0·001215	0·001231	0·001247	0·001263
21	0·001179	0·001195	0·001211	0·001226	0·001242	0·001258
22	0·001175	0·001190	0·001206	0·001222	0·001238	0·001253
23	0·001170	0·001186	0·001202	0·001217	0·001233	0·001249
24	0·001166	0·001182	0·001197	0·001213	0·001229	0·001244
25	0·001162	0·001177	0·001193	0·001208	0·001224	0·001240
26	0·001157	0·001173	0·001188	0·001204	0·001220	0·001235
27	0·001153	0·001169	0·001184	0·001200	0·001215	0·001230
28	0·001149	0·001164	0·001180	0·001195	0·001210	0·001226
29	0·001144	0·001160	0·001175	0·001191	0·001206	0·001221
30	0·001140	0·001155	0·001171	0·001186	0·001201	0·001217

The density of air is calculated by the equation[9]

$$d_t = \frac{0{\cdot}001293\ (P - k)}{(1 + 0{\cdot}00367\ t)\ 760}$$

where P is the barometric pressure and k is a correction term which depends on the amount of moisture in the air at the temperature t°C.

Table 5. Conversion of the alcohol contents to percentage by volume

1	2	3	4	5	6	7	8	9	10
Per cent by weight	*Per cent by volume* 20°C (JUPAC)	*Per cent by volume* 15·56°C (U.S. Bur. Stds.)	*Per cent by volume* 15°C (Osborne)	*Per cent by volume* 15°C (Gay-Lussac)	*Per cent by volume* 15°C (Windisch)	*Per cent by volume* 15·56°C (Tralles)	*Per cent by volume* 15·56°C (English)	*Per cent by volume* 15°C (Swedish)	*Per cent by volume* 20°C (Norwegian)
1	1·26	1·26	1·26	1·21	1·26	1·24	1·26	1·27	1·26
2	2·52	2·51	2·51	2·45	2·52	2·49	2·51	2·50	2·52
3	3·77	3·76	3·76	3·71	3·77	3·74	3·77	3·69	3·77
4	5·02	5·00	5·00	4·97	5·02	4·98	5·02	5·00	5·02
5	6·27	6·24	6·24	6·21	6·26	6·22	6·26	6·25	6·27
6	7·51	7·48	7·48	7·42	7·48	7·45	7·48	7·58	7·51
7	8·75	8·71	8·71	8·63	8·68	8·67	8·70	8·83	8·75
8	9·98	9·94	9·94	9·85	9·91	9·91	9·93	10·00	9·98
9	11·21	11·17	11·16	11·08	11·16	11·16	11·19	11·18	11·21
10	12·44	12·39	12·39	12·31	12·41	12·42	12·43	12·45	12·44
11	13·66	13·61	13·61	13·54	13·67	13·66	13·66	13·73	13·66
12	14·88	14·83	14·82	14·75	14·91	14·91	14·89	14·91	14·88
13	16·10	16·05	16·04	15·96	16·15	16·17	16·13	16·10	16·10
14	17·32	17·26	17·25	17·17	17·39	17·38	17·34	17·40	17·32
15	18·53	18·47	18·46	18·35	18·60	18·60	18·55	18·60	18·53
16	19·74	19·68	19·67	19·50	19·78	19·79	19·73	19·80	19·74
17	20·95	20·88	20·87	20·69	20·98	20·97	20·93	20·90	20·95
18	22·15	22·08	22·07	21·89	22·18	22·17	22·13	22·10	22·15
19	23·35	23·28	23·27	23·10	23·38	23·37	23·33	23·40	23·35
20	24·54	24·47	24·46	24·32	24·57	24·57	24·54	24·60	24·54
21	25·73	25·66	25·65	25·54	25·77	25·76	25·74	25·73	25·73
22	26·92	26·85	26·84	26·75	26·94	26·94	26·93	26·91	26·92
23	28·10	28·03	28·02	27·96	28·11	28·11	28·13	28·09	28·10
24	29·28	29·21	29·20	29·15	29·27	29·27	29·30	29·27	29·28
25	30·46	30·39	30·38	30·32	30·42	30·41	30·47	30·50	30·46
26	31·63	31·56	31·55	31·48	31·56	31·55	31·62	31·58	31·63
27	32·79	32·72	32·71	32·64	32·72	32·70	32·78	32·83	32·79
28	33·95	33·88	33·87	33·81	33·87	33·86	33·93	34·00	33·95
29	35·10	35·03	35·02	34·97	35·02	35·01	35·08	35·23	35·10
30	36·25	36·18	36·17	36·12	36·18	36·17	36·22	36·43	36·25
31	37·39	37·32	37·31	37·26	37·32	37·32	37·37	37·57	37·39
32	38·53	38·46	38·45	38·40	38·47	38·46	38·51	38·67	38·53
33	39·66	39·59	39·58	39·53	39·61	39·60	39·64	39·81	39·66
34	40·78	40·72	40·71	40·64	40·74	40·74	40·77	40·88	40·78
35	41·90	41·83	41·82	41·74	41·86	41·86	41·87	42·00	41·90
36	43·01	42·94	42·94	42·84	42·98	42·97	42·97	43·06	43·01
37	44·12	44·05	44·04	43·94	44·08	44·09	44·08	44·18	44·11
38	45·21	45·15	45·14	45·04	45·19	45·19	45·18	45·28	45·21
39	46·31	46·24	46·23	46·12	46·28	46·29	46·27	46·39	46·30
40	47·39	47·33	47·32	47·21	47·38	47·38	47·36	47·44	47·39
41	48·47	48·41	48·40	48·28	48·46	48·47	48·45	48·53	48·47
42	49·54	49·48	49·47	49·37	49·54	49·54	49·53	49·63	49·54
43	50·61	50·55	50·54	50·44	50·61	50·62	50·61	50·74	50·61
44	51·67	51·61	51·60	51·49	51·67	51·68	51·67	51·75	51·66
45	52·72	52·66	52·65	52·53	52·72	52·73	52·71	52·85	52·72
46	53·76	53·71	53·70	53·56	53·77	53·77	53·76	53·90	53·76
47	54·80	54·75	54·74	54·59	54·82	54·81	54·79	54·90	54·80
48	55·84	55·78	55·77	55·61	55·84	55·84	55·83	55·95	55·84
49	56·87	56·81	56·80	56·63	56·85	56·86	56·85	56·95	56·86
50	57·89	57·83	57·82	57·66	57·87	57·87	57·87	58·00	57·89
51	58·90	58·84	58·84	58·70	58·88	58·87	58·92	59·00	58·90
52	59·91	59·85	59·85	59·72	59·89	59·89	59·90	60·05	59·91
53	60·91	60·85	60·85	60·74	60·89	60·88	60·88	61·04	60·91
54	61·90	61·85	61·84	61·75	61·88	61·88	61·88	62·04	61·90
55	62·89	62·84	62·83	62·75	62·88	62·87	62·87	63·00	62·89
56	63·87	63·82	63·81	63·75	63·85	63·85	63·86	64·00	63·87
57	64·85	64·80	64·79	64·73	64·83	64·82	64·82	65·00	64·85
58	65·82	65·77	65·76	65·71	65·79	65·79	65·79	65·92	65·82
59	66·78	66·73	66·73	66·68	66·75	66·75	66·75	66·88	66·78
60	67·74	67·69	67·68	67·65	67·70	67·71	67·71	67·87	67·74

Table 5 (continued)

1	2	3	4	5	6	7	8	9	10
Per cent by weight	*Per cent by volume* 20°C (IUPAC)	*Per cent by volume* 15·56°C (U.S. Bur. Stds.)	*Per cent by volume* 15°C (Osborne)	*Per cent by volume* 15°C (Gay-Lussac)	*Per cent by volume* 15°C (Windisch)	*Per cent by volume* 15·56°C (Tralles)	*Per cent by volume* 15·56°C (English)	*Per cent by volume* 15°C (Swedish)	*Per cent by volume* 20°C (Norwegian)
61	68·69	68·64	68·63	68·60	68·65	68·65	68·65	68·83	68·69
62	69·63	69·59	69·58	69·55	69·59	69·61	69·60	69·76	69·63
63	70·57	70·52	70·52	70·49	70·53	70·54	70·53	70·72	70·57
64	71·50	71·46	71·45	71·43	71·46	71·48	71·46	71·62	71·50
65	72·42	72·38	72·37	72·36	72·39	72·40	72·39	72·52	72·42
66	73·34	73·30	73·29	73·28	73·30	73·32	73·32	73·46	73·34
67	74·25	74·21	74·21	74·19	74·21	74·23	74·21	74·35	74·25
68	75·16	75·12	75·11	75·10	75·13	75·14	75·13	75·27	75·16
69	76·05	76·02	76·01	76·00	76·02	76·04	76·03	76·15	76·05
70	76·95	76·91	76·90	76·89	76·92	76·93	76·91	77·04	76·94
71	77·83	77·79	77·79	77·78	77·80	77·81	77·80	77·93	77·83
72	78·71	78·67	78·67	78·66	78·69	78·70	78·69	78·81	78·71
73	79·58	79·54	79·54	79·53	79·57	79·57	79·57	79·70	79·58
74	80·44	80·41	80·41	80·40	80·44	80·44	80·43	80·57	80·44
75	81·30	81·27	81·26	81·26	81·30	81·30	81·30	81·43	81·30
76	82·15	82·12	82·12	82·11	82·14	82·15	82·15	82·32	82·15
77	82·99	82·97	82·96	82·96	82·99	83·00	83·00	83·17	82·99
78	83·83	83·81	83·80	83·79	83·83	83·84	83·84	84·00	83·83
79	84·66	84·64	84·63	84·62	84·66	84·67	84·66	84·83	84·66
80	85·48	85·46	85·46	85·44	85·49	85·49	85·49	85·63	85·48
81	86·30	86·28	86·27	86·26	86·30	86·32	86·32	86·47	86·30
82	87·10	87·08	87·08	87·07	87·11	87·12	87·13	87·29	87·10
83	87·91	87·89	87·88	87·87	87·92	87·93	87·92	88·09	87·90
84	88·70	88·68	88·68	88·66	88·71	88·72	88·71	88·88	88·70
85	89·48	89·46	89·46	89·44	89·49	89·49	89·50	89·64	89·48
86	90·26	90·24	90·24	90·22	90·26	90·27	90·27	90·41	90·25
87	91·02	91·01	91·01	90·99	91·03	91·04	91·03	91·14	91·02
88	91·78	91·77	91·76	91·75	91·79	91·79	91·79	91·89	91·78
89	92·53	92·52	92·51	92·49	92·54	92·54	92·54	92·66	92·53
90	93·26	93·25	93·25	93·24	93·28	93·27	93·28	93·38	93·26
91	93·99	93·98	93·98	93·97	94·01	94·00	94·00	94·11	93·99
92	94·71	94·70	94·70	94·69	94·72	94·71	94·72	94·84	94·71
93	95·41	95·41	95·41	95·41	95·42	95·42	95·42	95·56	95·41
94	96·11	96·10	96·10	96·10	96·11	96·11	96·11	96·26	96·11
95	96·79	96·79	96·79	96·78	96·79	96·79	96·79	96·93	96·79
96	97·46	97·46	97·46	97·45	97·46	97·46	97·45	97·59	97·46
97	98·12	98·12	98·12	98·10	98·10	98·11	98·10	98·23	98·12
98	98·76	98·76	98·76	98·75	98·75	98·75	98·74	98·87	98·76
99	99·39	99·39	99·39	99·39	99·38	99·38	99·37	99·49	99·39
100	100·00	100·00	100·00	100·01	99·99	99·99	100·00	100·14	99·99

The alcohol percentages presented in this Table are obtained from the following alcohol tables:

1. Percentage by weight: IUPAC, *Table 1*. Specific gravities 20°/20°C of alcohol–water mixtures.
2. Percentage by volume at 20°C: IUPAC, *Table 1*. Specific gravities 20°/20°C of alcohol–water mixtures.
3. Percentage by volume at 15·56°C: Standard Density and Volumetric Tables[8].
4. Percentage by volume at 15°C: The alcohol table of Osborne[1].
5. Percentage by volume at 15°C: Table des densités des mélanges d'eau et alcool absolu, dressée par le Bureau national des poids et measures. (Règlement d'administration publique du 27 décembre 1884—Annexe.) In Guide Pratique d'Alcoométrie. Edition conforme aux prescriptions de l'Administration (Circulaire du 1er févier 1950), Librairie Administrative P. Oudin, Poitiers.
6. Percentage by volume at 15°C: Tafel zur Ermittelung des alkoholgehaltes von Alkohol-Wassermischungen aus dem spezifischen Gewicht. Nach den von der Kaiserlichen Normal-Aichungs-Komission angenommenen Zahlen berechnet von K. Windisch. Verlag von Julius Springer, Berlin 1893.
7. Percentage by volume at 15·56°C: Tafel der Beziehungen zwischen Prozentgehalt und Dichte von Alkohol-Wassermischungen für Volumprozente (Dichteeinheit: die Dichte des Wassers bei +15·556°C). Mitteilungen der Reichanstalt für Mass und Gewicht, 5. Reihe, Nr. 8, 114–117 (1921).
8. Percentage by volume at 15·56°C: Spirit Tables, Specific Gravity at 60°/60° Farenheit. Issued under the authority of the Commissioners of Her Majesty's Customs and excise. Her Majesty's Stationery Office, London 1955.
9. Percentage by volume at 15°C: Bränvinsprofvaren, Alkoholmetriska Reduktions- och Hjelptabeller. Tredje upplagan. På Kongl. Maj:ts befallning utgifven af A. H. Fock. Albert Bonniers Förlag, Stockholm 1881.
10. Percentage by volume at 20°C: Alkoholtabel for Opløsninger av Aethylalkohol i Vand. Den Departemental Analysekomité, Forslag nr. 7. Forlagt av Teknisk Ukeblad, Kristiania 1924.

IV. SOME ASPECTS OF SPECIFIC GRAVITY

1. General consideration

The alcohol table used determines not only the temperature at which the measurements should be performed, but also the unit in which the density should be expressed in order to correspond to the alcohol content given in the table. Many alcohol tables use, instead of the density, a quantity comparable with density, for example the specific gravity or the apparent specific gravity. For this reason it seems appropriate to examine the definitions of density, the relations between the different quantities[9–11], and the equations from which the final density or a comparable ratio can be calculated.

2. Definitions and units

The density is defined as the mass per unit volume and in accordance with the c.g.s. system of units it is expressed as g/cm^3

$$d = (\text{mass})/(\text{volume}) \tag{1}$$

With liquids, however, this *absolute density* is very seldom used. Instead we have the *relative density*, $d_{\text{rel.}}$, which is defined by the same equation but expressed in the dimensions g/ml

$$d_{\text{rel.}} = m/V \tag{2}$$

The relative density has often been identified with the *density value* d_4^t, which is obtained by comparing the absolute density of a liquid measured at t°C with that of water at 4°C, and which, because of this, is called the density relative to water at 4°C[9, 11]. It should be noted, however, that the density value has no dimension, while the dimension of the relative density is g/ml. The two quantities have equal numerical values, because the relative density of water is 1 at the temperature in question. Actually, water reaches its highest density, 1·000000 g/ml, at a temperature of 3·98°C[9], but this difference is generally ignored in density measurements. The absolute density of water at this temperature is 0·999973 g/cm^3. The deviation from the value 1 depends on the fact that the ratio between the volume units 1 cm^3 and 1 ml is not exactly 1, but in fact

$$1\ \text{cm}^3 = 0{\cdot}999973\ \text{ml}$$
$$1\ \text{ml} = 1{\cdot}000027\ \text{cm}^3$$

The absolute density is thus obtained from the relative density by multiplying by 0·999973.

In alcohol tables it is common to use, instead of the density value d_4^t, a value expressing the density of liquids, which is called the *specific gravity* and which, like the density value, is dimensionless. The specific gravity $D\ t°/t°$ thus means the ratio between the mass m_a of a known volume of a liquid at a known temperature, and the mass m_w of the same volume of water measured at the same temperature. Considering equation (2), we arrive at the following equation defining this quantity

$$D\ t°/t° = m_a/m_w = (m_a/V)(m_w/V) = d_{4(a)}^t/d_{4(w)}^t \tag{3}$$

where the index (a) refers to the alcohol solution and the index (w) to pure water. From equation (3) it is seen that the specific gravity is equal to the ratio of the relative densities and also to the ratio of the density values.

3. Equations of the specific gravity

For the pycnometric determination of the specific gravity and density, three quantities are measured: the weight of the empty pycnometer, the weight of the pycnometer filled with water and the weight of the pycnometer filled with alcohol. The filling of the pycnometer takes place at a chosen basic temperature, t°C, and the weighings are performed at the temperature of the balance room and prevailing atmospheric pressure. Since equations (2) and (3) deal with masses, the buoyancy effect of the air which is displaced by the weights and the object on the balance must be considered by using a mathematical procedure for the calculation of vacuum-corrected weights. By using a two-armed balance, and placing the object to be weighed in one pan and the weights in the other[12–14], the calculation is simplified. Furthermore, the changes depending on the construction of the balance and their possible effects on the corrected values[12,13] must be formulated mathematically and considered. For most alcohol determinations it is sufficiently accurate to use corrections calculated as if the determinations had been performed on a two-armed balance.

When equilibrium is reached between the object and the weights in air on the two balance arms, the equation for the empty pycnometer is

$$m_0(1 - d_i/d_g) = p_0(1 - d_i/d_b) \tag{4}$$

from which the mass m_0 for the pycnometer is obtained according to the equation

$$m_0 = p_0\left[1 + \frac{d_i}{d_g - d_i}\left(1 - \frac{d_g}{d_b}\right)\right] = p_0(1 + \Delta_g) \tag{5}$$

where p_0 is the weight in air, d_g the density of the glass (= 2·23 g/cm³ for Pyrex or Kimax glass), d_b the density of the weights (= 8·4 g/cm³ for brass) and d_i the density of air (0·001205 g/ml for dry air at 20°C and 760 mmHg). In equation (5) the correction Δ_g depends only on these factors and can thus be calculated in advance for different temperatures and different atmospheric pressures (*Table 2*).

If p_w is the weight of a pycnometer filled with water at the above temperature and atmospheric pressure, we have

$$m_0(1 - d_i/d_g) + m_w(1 - d_i/d_w) = p_w(1 - d_i/d_b) \tag{6}$$

When equation (4) is considered, equation (6) is obtained in the following form

$$m_w(1 - d_i/d_w) = (p_w - p_0)(1 - d_i/d_b) \tag{7}$$

When, further, the density of water at the basic temperature is expressed by d_w (= 0·998234 g/ml at 20°C), the following equation is obtained for the mass m_w of the pycnometer's water content

$$m_w = (p_w - p_0)\left[1 + \frac{d_i}{d_w - d_i}\left(1 - \frac{d_w}{d_b}\right)\right] = (p_w - p_0)(1 + \Delta_w) \qquad (8)$$

The correction Δ_w, which depends only on the constants (see equation 5), can previously be calculated for weighings at different temperatures and different atmospheric pressures (*Table 3*).

By transforming equation (7), the following equation is obtained for the mass m_w of the pycnometer's water content

$$m_w = \frac{d_w}{d_w - d_i}\left(p_w - p_0 - d_i\frac{p_w - p_0}{d_b}\right) \qquad (9)$$

The last phase of the pycnometric determination is the weighing of the pycnometer filled with alcohol solution. If the weight obtained is p_a, while the density of air is d_i', we have

$$m_a(1 - d_i'/d_a) + m_0(1 - d_i'/d_g) = p_a(1 - d_i'/d_b) \qquad (10)$$

Since the volume V of the pycnometer is $V = m_a/d_a$, when m_a is the mass of the solution and d_a the density, the equation (10) can be written as follows

$$m_a = p_a - m_0 - d_i'(p_a/d_b - m_0/d_g) + d_i'V \qquad (11)$$

Dividing by the value m_w of the pycnometer we obtain

$$D\ t°/t° = m_a/m_w = \frac{1}{m_w}\left[p_a - m_0 - d_i'(p_a/d_b - m_0/d_g)\right] + d_i'/d_w \qquad (12)$$

Thus, the equation (12) defines the specific gravity when the weighings are made at two different temperatures and atmospheric pressures. If all three weighings are performed under the same atmospheric conditions, the following equation is obtained for the specific gravity[14]

$$D\ t^0/t^0 = \left[\frac{p_a - p_0}{p_w - p_0}(d_w - d_i) + d_i\right]\frac{1}{d_w}. \qquad (13)$$

If, again, the atmospheric conditions have been different in all three weighings, p_0, p_w and p_a, and the air densities are denoted d_{1i}, d_{2i} and d_{3i}, we obtain the following equation for the specific gravity[14]

$$D\ t°/t° = \left[\frac{p_a(d_b - d_{3i})(d_g - d_{1i}) - p_0(d_b - d_{1i})(d_g - d_{1i})}{p_w(d_b - d_{2i})(d_g - d_{1i}) - p_0(d_b - d_{1i})(d_g - d_{2i})}\right] \times \frac{(d_w - d_{2i})}{d_w} + \frac{d_{3i}}{d_w} \qquad (14)$$

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